Journal of Transport and Supply Chain Management
ISSN: (Online) 1995-5235, (Print) 2310-8789

Flexible procurement systems is key to supply chain sustainability

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Dates:
Received: 22 Sept. 2015
Accepted: 26 Jan. 2016
Published: 28 Apr. 2016

How to cite this article:
Bag, S., 2016, 'Flexible procurement systems is key to supply chain sustainability', *Journal of Transport and Supply Chain Management* 10(1), a213. http://dx.doi.org/10.4102/jtscm.v10i1.213

Background: In this dynamic business environment, manufacturers are focusing primarily on delivery performance and competitive pricing to win orders. It is essential that manufacturers adopt flexible procurement systems (FPSs) in such an uncertain environment for business sustainability.

Objectives: The purpose of the study is to identify the elements of FPSs and model the interrelationships between elements of FPSs and, finally, to understand how FPSs are linked with supply chain sustainability.

Method: Besides providing a brief conceptual review of FPSs, the study largely illustrates the use of an innovative multi-criteria decision-making approach called total interpretive structural modelling (TISM).

Results: The total interpretive structural modelling–based model evaluates the causality and illustrates elements with interpretation of relations and suggests that bottom-level elements are vital for sustainability in FPSs and avert risks. Secondly, strategic sourcing is positively influencing supplier integration. Thirdly, supplier integration positively influences supplier responsiveness. Fourthly, skills of flexible procurement workforce positively influence supplier integration. Fifthly, it is found that supplier integration positively influences flexible transportation. The sixth finding suggests that supplier integration positively influences eco-friendly packaging. The seventh finding highlights that supplier integration positively influences ISO 14001 certifications. The eighth finding explains that supplier responsiveness positively influences customer satisfaction. It is also observed that flexible transport reduces operational cost and environmental costs. The second last finding explains eco-friendly packaging and reduction in environmental cost by careful selection of packing material and chemicals. Lastly, it is found that ISO 14001/environmental certifications reduce environmental costs by greening suppliers and pressurises them to follow environmental norms. This helps in reducing wastage and developing alternate raw materials, which are eco-friendly in nature. Environmental certifications of suppliers help in improving the image of the buyer firm in the business environment and attract more customers.

Conclusion: It is found that FPSs have a positive relationship with supply chain sustainability. In the end, the author highlights implications for supply chain practitioners and researchers.

Introduction

The concept of flexibility in the field of operations management has created interest amongst researchers and supply chain practitioners. The work of Browne *et al*. (1984) and Sethi and Sethi (1990) were some of the earliest works that motivated many researchers to further contribute high research output in this area. Increasing manufacturing flexibility is a key strategy for efficiently improving market responsiveness because of fluctuations in demand and high uncertainty. Manufacturing flexibility triggers flexibility in process so that different products can be manufactured in the same plant or production facility at the same time (Jordan & Graves 1995). Manufacturing flexibility further necessitated flexibility in procurement systems to provide the firm the ability to respond quickly to demand changes, volume changes and to manage supply risks (Dubey & Ali 2014). The matter has become more complicated today where sustainability is a real challenge for business success. Globally, researchers and supply chain practitioners are looking for innovative practices to achieve sustainability and enhance supply chain performance. Various case studies are available on supply disruptions which impacted the entire supply chain network and resulted in huge financial losses. Bag and Anand (2015) have identified the leading barriers of sustainable supply chain network

design and further extended the knowledge base. Supply chain practitioners are now searching for innovative methodologies to integrate flexibility in procurement processes and design the supply network for better risk management. This is a burning problem that procurement managers are facing and has been the motivating factor in conducting the present study. The purpose of the study is to provide a brief conceptual review of flexible procurement systems (FPSs). Further, the elements of FPSs are modelled using total interpretive structural modelling (TISM).

Background literature

Concern related to FPSs in achieving business sustainability is growing from past few years. Collectively, these concerns involve a higher number of interaction factors, which further increase the complexity by decreasing the visibility of risks in supply chain network and so add to its vulnerability. To improve the situation, proactive planning and understanding the interplay of the elements are necessary for decision making.

Present research revolves around three questions:

- What are the elements of FPS?
- What are the interrelationships of FPS elements?
- How a FPS is linked with Supply chain sustainability?

The first research question attempts to understand what work has been carried out in the past on 'flexible procurement system'. The second and third questions have been addressed using the TISM approach.

For literature review, scholarly works from databases such as Science Direct, Compendex, Ebsco, Emerald and Scopus have been used. There are lots of publications available in the area of flexible manufacturing systems, but very limited research studies are available which specifically address FPSs.

Keeping the research objectives in mind, the focus is on identifying elements or dimensions of FPSs. Here researcher based on literature review prepared a non-exhaustive list of elements of FPS which are presented in Table 1.

Theoretical discussion on flexible procurement system

Flexibility can have important consequences for the organisation efficiency and long-term sustainability of an organisational system. It should be considered explicitly as a decision factor in designing supply chain network.

Purchasing flexibility is defined as 'the ability to meet the changing needs of customers, changing the supply of products, including mix, volume, product variations and new product' (Duclos, Vokurka & Lummus 2003:446–456).

Studies are mostly available related to risk management, which is very important for organisation sustainability. Shah (2008) focused on the determinants of supply-side risks. Later, Jung, Lim and Oh (2011) developed a supplier risk assessment model for buyers to estimate supplier risks. In another case study by Ganguly (2013), investigation was done to understand supply risk and the implications and measures for supply risk management. Also, there are studies available on managing purchasing risks. Lockamy and Mc Cormack (2010) presented Bayesian networks methodology for creating profiles of individual suppliers for analysing risks in supply networks to facilitate outsourcing decisions. Researchers found that flexibility is an important component in purchasing without which the purchasing system will collapse considering the present dynamic business environment. Chan, Bhagwat and Wadhwa (2009) presented a simulation study on suppliers' flexibility level in relation to information system automation level of the supply chain and physical characteristics of the flexible suppliers. There are immense benefits of flexible purchasing system. Lawson *et al*. (2009) found that strategic purchasing is significantly and positively related to higher levels of socialisation and supplier process integration. Collaborative relationships will lead to develop green innovative products at an economical cost (Bag, in press).

Several researchers have also suggested developing flexibility in contract management. Li and Kouvelis (1999) illustrate that the contractual flexibility in sourcing arrangements, when carefully exercised, can effectively reduce the sourcing cost in environment of price uncertainty. Brockett, Golden and Panjer (1996) presented a general framework for purchase frequency modelling that enables flexible fitting and convenient competency.

TABLE 1: Elements of flexible procurement systems.

Element name	Author(s), year
Supplier integration	Tachizawa and Gimenez (2009), Sen, Basligil, Sen and Baracli (2008), Koufteros, Cheng and Lai (2007), Vachon and Klassen (2006), Christopher(2000), Wei and Krajewski (2000), Das, Narasimhan and Talluri (2006)
Supplier responsiveness	Holweg (2005), Sanchez and Perez (2005), Carr and Smeltzer (2000), Narasimhan and Das (2000)
Skills of flexible procurement workforce	Kazlauskaite and Buciuniene (2008), Oke (2005), Edwards (1993), Stewart *et al*. (1994), Atkinson (1984)
Strategic sourcing	Bag (in press), Chiang, Kocabasoglu-Hillmer and Suresh (2012), Stevenson and Spring (2007), Tomlin (2006)
Flexible transportation	Christopher and Peck (2004), Bussmann and Schild (2001), Rosic, Bauer and Jammernegg (2009)
Eco-friendly packaging	Nidumolu, Prahalad and Rangaswami (2009), Halldorsson, Kotzab and Skjott-Larsen (2009), Rao and Holt (2005)
ISO 14001 certification	Dubey *et al*. (2013), Lee, Tae Kim and Choi (2012), Lee and Kim (2009), Wu, Chu and Liu (2007)
Operational cost	Dubey Gunasekaran and Bag., (2015), Gunasekaran Patel and McGaughey (2004), Beamon (1998, 1999)
Environmental cost	Dubey Gunasekaran and Bag (2015), Atkinson and Mourato (2008), Vachon and Klassen (2008), Gunasekaran Patel and McGaughey (2004), Duclos, Vokurka and Lummusl (2003)
Customer satisfaction	Christopher and Lee (2004), Lambert, Cooper and Pagh (1998), Lambert, Emmelhainz and Gardner (1996)

Note: Please see the full reference list of the article, Bag, S., 2016, 'Flexible procurement systems is key to supply chain sustainability', *Journal of Transport and Supply Chain Management* 10(1), a213. http://dx.doi.org/10.4102/jtscm.v10i1.213, for more information.

TABLE 2: Elements and sub-elements of flexible procurement system.

Elements code	Elements name	Sub-elements
E1	Supplier integration	Participation of suppliers in design, procurement and production, use of IT (Enterprise resource planning/ Supplier relationship program) to exchange information, efficient sourcing process, reduced development time, reduced costs
E2	Supplier responsiveness	Able to customise products, responsive to delivery changes, volume changes, shorter lead times, quick information flow
E3	Skills of flexible procurement workforce	Diverse new skill requirements, technical skills, managerial understanding of the system process, advanced communication skills, new safety requirements of individual machines and soft skills
E4	Strategic sourcing	Dual source of suppliers for critical supply items, order management, risk management
E5	Flexible transportation	Proper planning and vehicle scheduling, pick up loads as per changing production demands
E6	Eco-friendly packaging	Use of green material for packaging, long life, no/less incidence breakage during transit, recyclable material
E7	ISO 14001 certification	Environmental certification, environmental audits
E8	Operational cost	Machine running costs, labour costs, electricity consumption, water usage costs, input costs
E9	Environmental cost	Solid waste management cots, waste water treatment costs, costs to reduce air pollution, use of alternate raw material
E10	Customer satisfaction	Value addition, customer happiness, willingness to award new/repeat orders

From a review of literature, it is found that on-time delivery, strategic sourcing, environmental certification and management of transportation systems are main priorities in FPSs.

Methods

The TISM approach is used to develop the hierarchical relationship amongst the elements of FPS. TISM is a proven and popular methodology for understanding relationships amongst specific items that define a problem. TISM is useful to achieve the objective in the presence of a large number of directly and indirectly related elements and complex interactions amongst them, which may or may not be expressed in a proper manner. TISM is an innovative version of Warfield's interpretive structural modelling (ISM) technique and is used to model and structure the FPSs for greater understanding of the interplay of these forces. Earlier, TISM had been used in the broad field of management science by several researchers (Jayalakshmi & Pramod 2015; Mangla, Kumar & Barua 2014; Nasim 2011; Prasad & Suri 2011; Sandbhor & Botre 2014; Singh & Sushil 2013). Here, the steps in TISM are followed as suggested by Sushil (2012). Experts' opinions from industry and academia have been sought to identify the contextual relationships amongst each pair of elements and also the underlying reasoning behind each relationship. Developing TISM model for 'n' elements, an expert is supposed to define and provide reason for $n^*(n-1)$ pairs of relationships.

Data analysis and findings

The steps of total interpretive structural modelling are presented in this section

Identify and define elements

The first step of the modelling is to identify and define the elements whose relationships are modelled. In context to the study, 10 elements related to procurement that play a key role in FPSs is identified from literature review and through semi-structured interviews (Table 2). These 10 elements have been further validated in consultation with 6 supply chain experts having more than 20 years of experience and who were professional members of Operations Research Society of India (ORSI) and Chartered Institute of Logistics and Transport (CILT).

TABLE 3: Contextual relationship between the elements.

Elements code	Elements name	Contextual relation	Interpretation
E1	Supplier integration	Element E1 will influence/enhance element E2	How or in what way element E1 will influence/enhance element E2
E2	Supplier responsiveness	-	-
E3	Skills of flexible procurement workforce	-	-
E4	Strategic sourcing	-	-
E5	Flexible transportation	-	-
E6	Eco-friendly packaging	-	-
E7	ISO 14001 certification	-	-
E8	Operational cost	-	-
E9	Environmental cost	-	-
E10	Customer satisfaction	-	-

Define contextual relationships

To build the TISM model, it is vital to state the contextual relationship between different elements, which is given in Table 3. The inputs of six supply chain experts are solicited to capture the contextual relationship between the elements.

Interpretation of the relationship

TISM is a superior technique over traditional ISM. ISM remains quite on how the relationship actually works. In TISM, clarifications from supply chain experts have been asked for the logic behind the expressed relationship. TISM brings more transparency and better understanding of problem links.

Interpretive logic of pair-wise comparison

Here, the concept of Interpretive Matrix is applied to fully interpret each pair of comparison by explaining the interpretive query as mentioned in the previous step.

For paired comparison, the i-th element is compared individually to all the elements from $(i + 1)$th to the n-th element. Based on the interview with supply chain experts from industry, a sample of an Interpretive Logic-Knowledge Base for the element E1 (only those having response Yes) is presented in Table 4.

TABLE 4: Interpretive logic-knowledge base.

Serial number	Element number	Paired comparison of elements	Yes/No	In what way elements will influence/enhance other STM elements? Give reasons in brief
1	E1-E2	Supplier integration will influence or enhance supplier responsiveness	Y	Better coordination and quick response
2	E1-E3	Supplier integration will influence or enhance skills of flexible procurement workforce	Y	Deeper understanding and transfer of knowledge
3	E1-E5	Supplier integration will influence or enhance flexible transportation	Y	Collaboration enables to cope with uncertainty. Cooperate for multiple trips with varied volumes because of changing production plans
4	E1-E6	Supplier integration will influence or enhance eco-friendly packaging	Y	Process integration and sharing information will enable in developing cost-effective eco-friendly packaging
5	E1-E7	Supplier integration will influence or enhance ISO 14001 certification	Y	Information sharing and trust building will lead to environmental certifications
6	E1-E8	Supplier integration will influence or enhance operational cost	Y	Transparency and partnership will reduce operational cost
7	E1-E9	Supplier integration will influence or enhance environmental cost	Y	Transparency and partnership will reduce waste and environmental impact
8	E1-E10	Supplier integration will influence or enhance customer satisfaction	Y	Better coordination, innovation and new product development
9	E2-E10	Supplier responsiveness will influence or enhance customer satisfaction	Y	Quick response and shorter lead time will lead to timely dispatch of sales orders
10	E3-E1	Skills of flexible procurement workforce will influence or enhance supplier integration	Y	Broad skill mixes will result in strong supplier partnerships and high rate of project success
11	E3-E4	Skills of flexible procurement workforce will influence or enhance strategic sourcing	Y	Broad skill mixes is essential for developing green supplier
12	E3-E5	Skills of flexible procurement workforce will influence or enhance flexible transportation	Y	Quantitative and mathematical modelling for vehicle scheduling requires special set of skills
13	E3-E6	Skills of flexible procurement workforce will influence or enhance eco-friendly packaging	Y	Technical and managerial skills are required for finding the right packing solution
14	E3-E8	Skills of flexible procurement workforce will influence or enhance operational cost	Y	Reduce operational costs
15	E3-E9	Skills of flexible procurement workforce will influence or enhance environmental cost	Y	Reduce environmental costs
16	E3-E10	Skills of flexible procurement workforce will influence or enhance customer satisfaction	Y	Improved customer satisfaction through timely procurement of quality goods and finally timely dispatch of sales orders
17	E4-E1	Strategic sourcing will influence or enhance supplier integration	Y	Well-defined sourcing policy will ensure supplier collaboration/ partnership
18	E4-E2	Strategic sourcing will influence or enhance supplier responsiveness	Y	Good relationships with suppliers help in prompt action and shorter lead time
19	E4-E5	Strategic sourcing will influence or enhance flexible transportation	Y	Proper planning and vehicle scheduling
20	E4-E6	Strategic sourcing will influence or enhance eco-friendly packaging	Y	Identification of right source of eco-friendly packaging material in order to make the packing cost economical
21	E4-E8	Strategic sourcing will influence or enhance operational cost	Y	Just in time sourcing will reduce inventory costs
22	E4-E9	Strategic sourcing will influence or enhance environmental cost	Y	Reduced environmental costs
23	E4-E10	Strategic sourcing will influence or enhance customer satisfaction	Y	Better quality of product improves customer satisfaction
24	E5-E8	Flexible transportation will influence or enhance operational cost	Y	Timely delivery and availability of raw material/input will reduce idle time of machineries and improved productivity. Better management of resources and reduced costs
25	E5-E9	Flexible transportation will influence or enhance environmental cost	Y	Proper planning and vehicle scheduling optimises fuel and reduces carbon footprint
26	E5-E10	Flexible transportation will influence or enhance customer satisfaction	Y	Timely delivery ensures customer satisfaction
27	E6-E9	Eco-friendly packaging will influence or enhance environmental cost	Y	Reduce wastage and costs
28	E6-E10	Eco-friendly packaging will influence or enhance customer satisfaction	Y	Recycling material, cost-effective environmental-friendly packaging improves customer satisfaction
29	E7-E9	ISO 14001 certification will influence or enhance environmental cost	Y	Stringent environmental norms reduce wastage and lower environmental costs
30	E7-E10	ISO 14001 certification will influence or enhance customer satisfaction	Y	Green suppliers improve customer satisfaction

Reachability matrix and transitivity check

The paired comparison in the Interpretive Logic-Knowledge Base is translated in the form of a reachability matrix by making entry 1 in the *i* - *j* cell, if the corresponding entry in the knowledge base is 'Y', or else it should be entered as 0 for the corresponding entry '*N*' in the Interpretive Logic-Knowledge Base. The matrix has also been checked for transitivity rule. A final reachability matrix, post-transitivity check is presented in Table 5. Also, for each new transitive link, the Interpretive Logic-Knowledge Base is also updated. The 'No' entry is to be changed to 'Yes', and in the interpretation column, 'Transitive' is entered.

Level partition on reachability matrix

The final reachability matrix obtained in Table 5 is now partitioned into different levels. After the first iteration, the

TABLE 5: Reachability matrix.

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	1	1	1	0	1	1	1	1	1	1
E2	0	1	0	0	0	0	0	0	0	1
E3	1	1*	1	1	1	1	1*	1	1	1
E4	1	1	1*	1	1	1	1*	1	1	1
E5	0	0	0	0	1	0	0	1	1	1
E6	0	0	0	0	0	1	0	0	1	1
E7	0	0	0	0	0	0	1	0	1	1
E8	0	0	0	0	0	0	0	1	0	0
E9	0	0	0	0	0	0	0	0	1	0
E10	0	0	0	0	0	0	0	0	0	1

*, indicates transitive links.

TABLE 6: Level partitioning.

Iterations	Elements	Reachability set	Antecedent set	Intersection set	Level
Iteration 1	E1	1,2,3,5,6,7,8,9,10	1,3,4	1,3	-
	E2	2,10	1,2,3,4	2	-
	E3	1,2,3,4,5,6,7,8,9,10	1,3,4	1,3,4	-
	E4	1,2,3,4,5,6,7,8,9,10	3,4	3,4	-
	E5	5,8,9,10	1,3,4,5	5	-
	E6	6,9,10	1,3,4,6	6	-
	E7	7,9,10	1,3,4,7	7	-
	E8	8	1,3,4,5,8	8	1
	E9	9	1,3,4,5,6,7,9	9	1
	E10	10	1,2,3,4,5,6,7,10	10	1
Iteration 2	E1	1,2,3,5,6,7	1,3,4	1,3	-
	E2	2	1,2,3,4	2	2
	E3	1,2,3,4,5,6,7	1,3,4	1,3,4	-
	E4	1,2,3,4,5,6,7	3,4	3,4	-
	E5	5	1,3,4,5	5	2
	E6	6	1,3,4,6	6	2
	E7	7	1,3,4,7	7	2
Iteration 3	E1	1,3	1,3,4	1,3	3
	E3	1,3,4	1,3,4	1,3,4	3
	E4	1,3,4	3,4	3,4	-
Iteration 4	E4	4	4	4	4

TABLE 7: Final level of elements in total interpretive structural modelling.

Element code	Element name	Levels in TISM
E8	Operational cost	1
E9	Environmental cost	1
E10	Customer satisfaction	1
E2	Supplier responsiveness	2
E5	Flexible transportation	2
E6	Eco-friendly packaging	2
E7	ISO 14001 certification	2
E1	Supplier integration	3
E3	Skills of flexible procurement workforce	3
E4	Strategic sourcing	4

element classified to level 1 is 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 1–4 are summarised in Table 6.

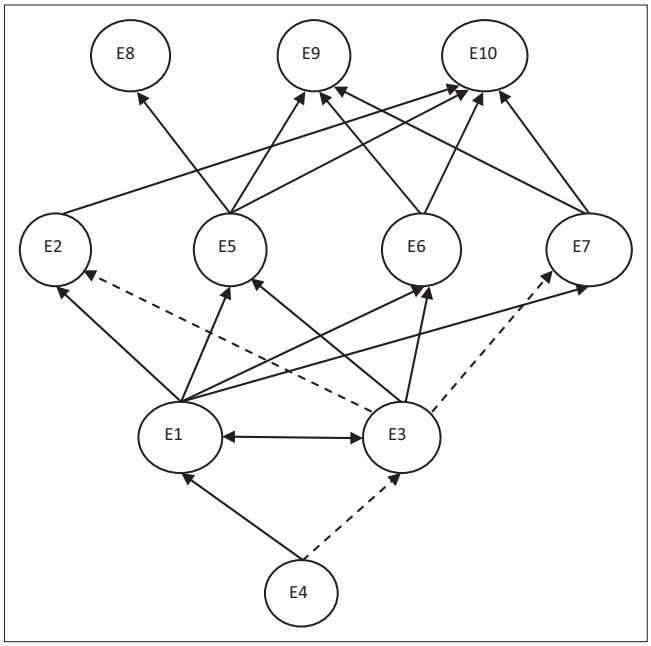
The levels of selected elements are tabulated in Table 7. The hierarchy shows that operational cost, environmental cost and customer satisfaction achieves level 1; supplier responsiveness, flexible transportation, eco-friendly packaging and ISO 14001 certification achieve level 2; supplier integration and skills of flexible procurement workforce achieve level 3; and the final level is strategic sourcing. Here strategic sourcing is the driving force and more focus on this element will drive the FPS.

Developing diagraph

The elements are arranged graphically in levels and the directed links are drawn as per the relationships shown in the reachability matrix. A diagraph with significant transitive links as per levels achieved in the previous step is presented in Figure 1.

Interaction matrix

The final digraph is converted into an interaction matrix (binary matrix) form depicting all the interactions by '1' entry. The cells with 1 entry are interpreted by picking the relevant interpretation from the knowledge base in the form of interpretive matrix. An interaction and interpretive matrix for Figure 1 is presented in Table 8 (a and b). Finally, the diagraph (Figure 1) is translated into ISM by interpreting the node in box-bullet representation as shown in Figure 2.



Source: Author's own conception

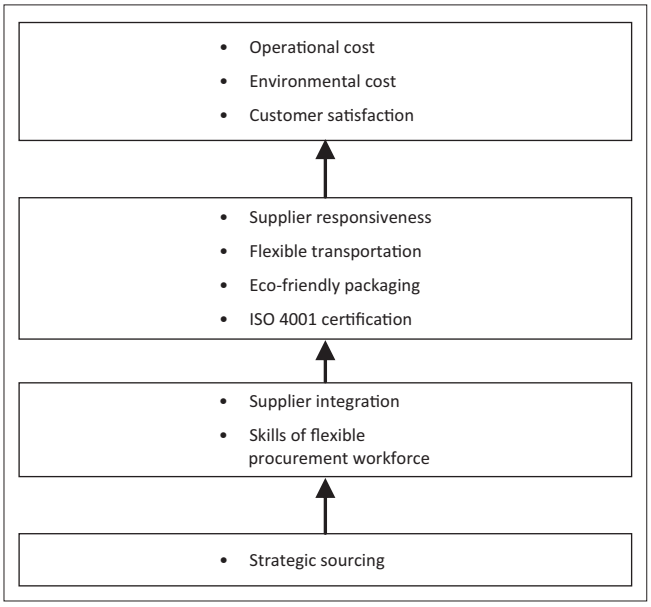
FIGURE 1: Diagraph of elements.

TABLE 8a: Interaction matrix (Binary matrix).

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	1	1	0	1	1	1	0	0	0
E2	0	-	0	0	0	0	0	0	0	1
E3	1	1	-	0	1	1	1	0	0	0
E4	1	0	1	-	0	0	0	0	0	0
E5	0	0	0	0	-	0	0	1	1	1
E6	0	0	0	0	0	-	0	0	1	1
E7	0	0	0	0	0	0	-	0	1	1
E8	0	0	0	0	0	0	0	-	0	0
E9	0	0	0	0	0	0	0	0	-	0
E10	0	0	0	0	0	0	0	0	0	-

TABLE 8b: Interaction matrix (Binary matrix).

Elements	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	Quick response	Participation of suppliers in design requires broad skill mixes of purchaser	0	Cooperation allows vehicle scheduling as per production demands	Partnership allows development of green packing with recyclable material	Smooth environmental audits	0	0	0
E2	0	-	0	0	0	0	0	0	0	Quick response and delivery in time makes customers happy
E3	Broad skill sets required to manage vendor partnerships	Communication and transparency for managing information flow	-	0	Quantitative skills required to plan vehicles	Technical skills for selecting eco-friendly packing material	Knowledge required for environmental audits	0	0	0
E4	Better vendor management	0	Upgrade skill sets and continuous education	-	0	0	0	0	0	0
E5	0	0	0	0	-	0	0	Minimise inventory costs	Planned trips minimise pollution	Timely delivery
E6	0	0	0	0	0	-	0	0	Recyclable packing reduces environmental impact	Recyclable packing makes customer happy
E7	0	0	0	0	0	0	-	0	Reduced wastage, less pollution, cost reduction	Green image improves customer satisfaction
E8	0	0	0	0	0	0	0	-	0	0
E9	0	0	0	0	0	0	0	0	-	0
E10	0	0	0	0	0	0	0	0	0	-



Source: Author's own conception

FIGURE 2: Interpretive structural model of flexible procurement elements.

Total interpretive structural model

The connective and interpretive information contained in the interpretive direct interaction matrix and diagraph is used to derive the TISM. The nodes in the diagraph are replaced by the interpretation of elements placed in boxes. The interpretation of the cells of interpretive direct interaction matrix is depicted by the side of the respective links in the structural model. The final TISM model is presented in Figure 3.

Discussion

The 11 findings of TISM are discussed in the section for gaining deeper insights of FPSs and its link with supply chain sustainability.

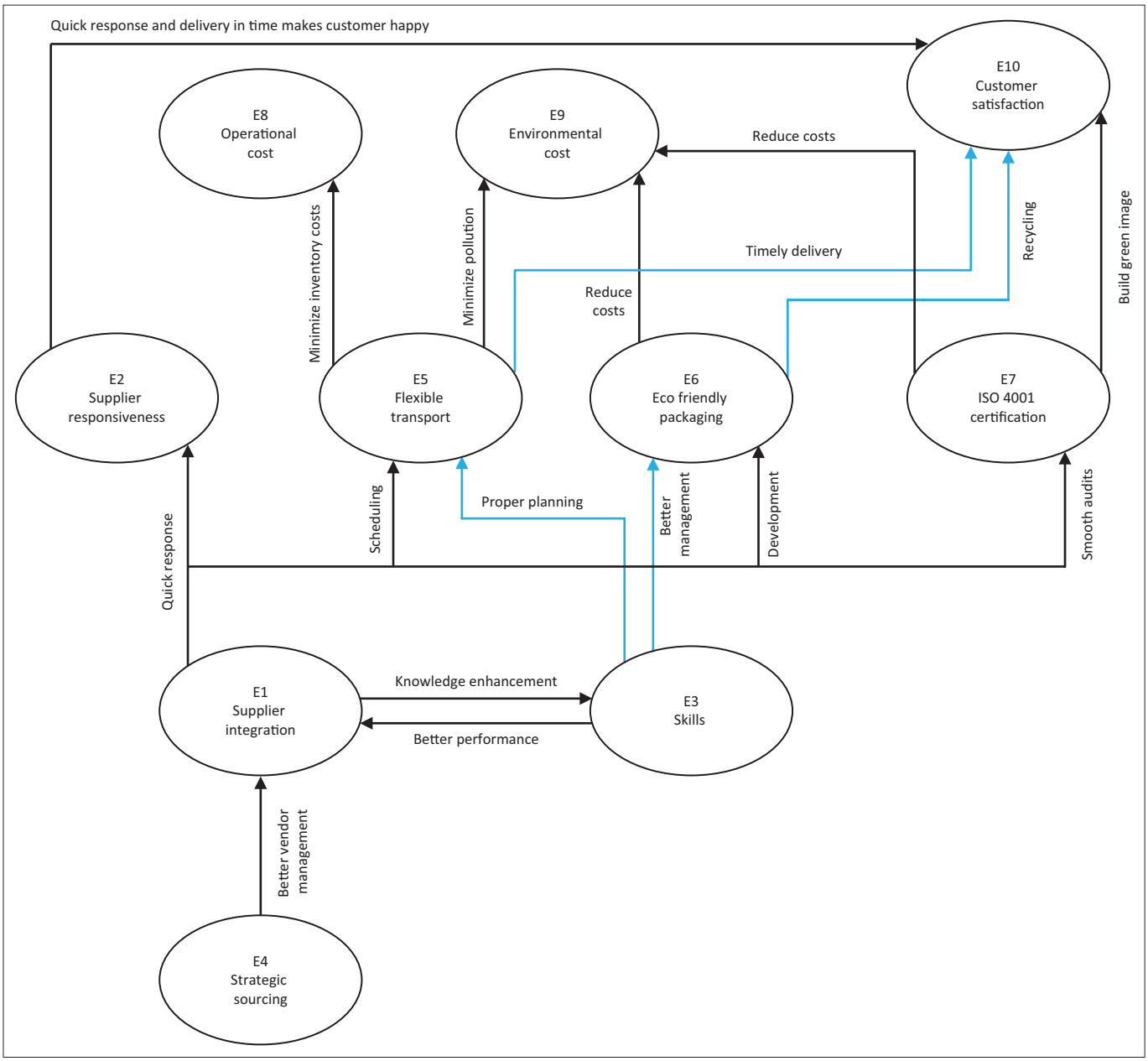
Firstly, the TISM-based model evaluates the causality and illustrates elements with interpretation of relations and suggests that bottom-level elements are vital for sustainability in FPSs to avert risks.

Secondly, strategic sourcing is positively influencing supplier integration. Manufacturing organisations having a strong sourcing policy successfully integrate suppliers. This helps in greater level of flexibility and develops more innovative products successfully.

Thirdly, supplier integration positively influences supplier responsiveness. Those manufacturers who adopt supplier collaboration and integrate procurement with other functions generate higher level of supplier responsiveness.

Fourthly, skills of flexible procurement workforce positively influence supplier integration. Broad mix of technical, clear communication and managerial skills is essential for collaboration with green suppliers.

Next, it is found that supplier integration positively influences flexible transportation. Collaborative planning and sharing of information help to proactively plan and schedule vehicles to meet fluctuations in production demand. This helps in optimising fuel consumption and reduces carbon footprint.



Source: Author's own conception

FIGURE 3: Total interpretive structural model.

It is also found that supplier integration positively influences eco-friendly packaging. Firms investing in supplier partnerships achieve better reduction in wastage. Joint planning helps in identifying raw material to be used for packing. This assists in the selection of non-hazardous chemicals usage for treating the packing material. This also enables cutting costs in the entire packaging process and builds sustainability.

The next finding highlights that supplier integration positively influences ISO 14001 certification. Collaborative planning and information sharing assist to identify the strengths and weakness of suppliers. This will enable to educate and train suppliers and for environmental certification. This is a flexible mode of moulding strategic suppliers and develops sustainability.

Another finding explains that supplier responsiveness positively influences customer satisfaction. Trust and collaborative efforts between buyers and suppliers improve delivery and product quality, which enhance customer satisfaction and are considered as a move towards sustainability.

It is also observed that flexible transport reduces operational cost and environmental costs. Flexible transport also enhances customer satisfaction. This leads to supply chain sustainability.

The second last finding explains eco-friendly packaging and reduction in environmental cost by careful selection of packing materials and chemicals. Eco-labelling, environmental improvement of packaging and recycling

packaging material reduce waste and emissions and cut packaging costs. Eco-friendly packaging enhances company image and enhances customer satisfaction.

Lastly, it is found that ISO 14001/environmental certifications reduce environmental costs by greening suppliers and pressurises them to follow environmental norms. This helps in reducing wastage and developing alternate raw materials that are eco-friendly in nature. Environmental certifications of suppliers help in improving the image of buyer firms in the business environment and attract more customers.

Conclusion

The present study is based on two prolonged strategies. Firstly, literature review is done to identify the elements of FPSs. Secondly, TISM approach is used to identify the contextual interrelationships of a FPS. It is found that FPSs have a positive relationship with supply chain sustainability. The findings are really interesting and extend the existing knowledge base. The study will enable supply chain practitioners in building flexible procurement strategies for sustainable supply chain management. This will also enable business excellence in this high-risk uncertain supply network environment.

Limitations and future research directions

The present research has employed TISM methodology. Similar to other methodologies, TISM also suffers from certain limitations. The proposed TISM model is not statistically validated. To eradicate the limitation, the Structural Equation Modelling technique can be applied for statistical validation and is one of the future research directions. Further empirical surveys using a big sample size may also be conducted to compare the model.

Acknowledgements

The author wishes to thank all the reviewers for their helpful and valuable comments on the paper. The author is also thankful to Dr (Prof.) Rameshwar Dubey for his encouragement in developing the article.

Competing interests

The author declares that he has no financial or personal relationships which may have inappropriately influenced him in writing this article.

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