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Modelling the Determinants of SCM Strategy: An Effort to Make Optimal Supply Chain Strategy

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Abstract

In response to contingency variables/determinants, organisations configure their supply chain. Set of such responses are known as supply chain strategy. Counting of contingency variable is very large and practically it is not possible to design a supply chain strategy which can respond all the determinants. Some studies have made an effort to identify critical contingencies. Moving ahead in this direction this study is an effort to arrange the contingency variables hierarchy wise, display the dependency relationship among them and analyse their driving and dependence power. For this, an integrated ISM-MICMAC approach has been used. This will help the managers to identify the root contingency variable(s) as well as the criticality of each contingency variable while configuring the supply chain and making an optimum supply chain strategy.

Keywords: SCM strategy, contingency variables, ISM, MICMAC, SC configuration

Introduction

In the era of globalization, customer retention and market size enhancement demand strenuous efforts by the companies because of availability of ginormous brands before the customers. Customers are not merely seeking the products and services but also appreciate the experience during the customer journey. Providing substantial customer experience during customer journey leads to customer satisfaction that further leads to customer loyalty and finally results into organizational performance (Lemon & Verhoef, 2016). Lagging behind at any front can affect the performance of enterprise. Supply chain, which represents the set of organizations involved in transferring the goods and services from suppliers to customers and from customers to suppliers along with the transfer of money and Information plays crucial role in delivering customer experience. Literature evidences that supply chain management has become new competitive advantage tool for the organisations (Li et al., 2006) (Tewari & Misra, 2013). SCM involves management of various flows like goods/services, money and information across the stakeholders of the supply chain (Chopra et al., 2016). These flows are influenced substantially by dynamic environment of the supply chain. Variables of the dynamic environment that influence the configuration of supply chain are considered as contingency variables.

According to Falkenhausen, Fleischmann, & Bode (2019) *"Contingency variables are characteristics of the business environment that influence the competitive priorities supply chain should pursue for maximizing profits."*

According to Basnet & Seuring (2016), "*Contingencies are product/market requirements or exogenous variable in the design of supply chains."*

Uncertainty in the supply chain environment is main reason behind the dynamicity of supply chain strategies. Set of contingency variables are responsible for these uncertainties in supply chain environment. Configuration of supply chain is based on these contingencies and set of configuration develops supply chain strategies. Supply chain strategies developed in response to these contingencies variable decides the success of supply chain management. Researches evidence the presence of number of contingencies and practically it is not possible to configure the supply chain in response to all contingencies.

SCM has its own limitations. There is always a trade-off between efficiency and responsiveness for each driver of SCM like production management, inventory management, location management, transportation management and information management (Chopra, Meindl, & Kalra, 2016). Enormous researches has analysed the trade-offs organisations face while deciding the supply chain strategies (Falkenhausen, Fleischmann, & Bode, 2019; Basnet & Seuring, 2016; Qi, Boyer, & Zhao, 2009; Aitken, Childerhouse, Christopher, & Towill, 2005; Olhager, 2003; Fisher, 1997).

Some studies have made effort to identify critical contingencies. Moving ahead in this direction this study is an effort to arrange the contingency variables hierarchy wise and display the dependency relationship among them. For this integrated ISM (interpretive structural modeling)-MICMAC (Matrice d'impacts croisés multiplication appliquée á un classment) This will help the managers to identify the root contingency variable(s) as well as criticality of each contingency variable while configuring the supply chain and making an optimum supply chain strategy.

Literature review

Challenges in the operating environment of supply chain are associated with demand, supply, time and market mediation (Falkenhausen, Fleischmann, & Bode, 2019). Demand-related challenges occur due to expected and unexpected changes in demand (Weick & Sutcliffe, 2007). It is harder to address the unexpected changes (Weick & Sutcliffe, 2007). These challenges affect the entire supply chain, from retailers to suppliers, by exerting influence on inventory management, transportation management, production & operation management, procurement management, and human resource management and finally affect the corresponding supply chain strategies. Through proper information management, managers could reduce this variability to a certain extent (Chopra, Meindl, & Kalra, 2016). Demand variation also influences the agility, flexibility, and responsiveness of the supply chain (Agarwal, Shankar, & Tiwari, 2007). Recent literature has identified six demand-related contingencies (Table 1): Demand Variability /uncertainty, Product Variety, Length of product lifecycle, Volume of production, Stage of product lifecycle, and Rate of market growth.

Fulfilling the customer demand is also influenced by supply-related challenges present in the operating environment. These supply-related challenges primarily hamper the production process and lead to non-fulfillment of customer demand on time (Hiles, 2000). This situation results in an unsatisfied customers, loss of market share, and poor financial performance by the organizations (Heikkilä, 2002; Zhou, Brown, & Dev, 2009). From the supply chain point of view, these challenges affect all the drivers of the supply chain. Research literature identified three supply-related challenges (Table 1): Supply uncertainty, Complexity of product structure, and Value density. Companies facing the supply-related problem should focus on the flexibility of their supply chain and address the supply-related challenges in the configuration of their supply chain.

One of the important aspects of fulfilling customer demand satisfactorily is the timely delivery of product/service (Ellinger et al., 2012; Tewari & Misra, 2015). It becomes more critical when customers require off-the-shelf products or quick delivery. Timely delivery also depends on various drivers of the supply chain like transportation, inventory, procurement, and production & operations (Bhagwat & Sharma, 2007). A literature review paper published by (Basnet & Seuring, 2016) highlights the ‘customer lead time’ as an important operating environment challenge that is related to time (Table 1) and affects the supply chain strategies.

Market mediation capabilities are generally associated with the responsiveness of the supply chain and may generate additional sales by preventing shortages. However, market mediation capabilities increase the input cost and finally reduce the efficiency of the supply chain (Roh et al., 2014). On the other hand, it has the capacity to enhance customer experience, increase market share, and build brand image (Hugos, 2018). So, careful analysis of value of market mediation is required before investing in market mediation capabilities. The literature identifies the challenges related to the value of market mediation (Table 1): Contribution margin, Markdowns, and Uniqueness. Contract penalties, loss of sales, and goodwill loss in case of late deliveries are motivating the organisations to invest in market mediation and consider the related contingencies in their supply chain strategies.

Through the above discussion, we can observe that challenges related to demand, supply, time, and value of market mediation are not independent of each other. All these challenges drive the drivers of the supply chain. Supply chain strategies related to one area, like demand, supply, time, and value of market mediation, will not be able to harness the capacity of the supply chain, and it is also not practical to configure the supply chain to address all the contingencies. So, an understanding of the complex and critical relationships among the contingencies related to various areas of the operating environment is required. Such kind of relationship has not been analysed so far.

Table 1: Contingency variables, meaning and category (source: Falkenhausen et al., 2019; Basnet & Seuring, 2016)

SN	Contingency	Definition	Type of Contingency
1	Demand Variability /Uncertainty	This contingency refers to the inability to forecast product demand accurately, which results in possible obsolescence and mark-down of prices.	Challenge in the operating environment: Demand-related
2	Product Variety	Products may be characterized as being standard (less variety) or customized (high variety).	Challenge in the operating environment: Demand-related
3	Customer lead time [delivery time window]	Customer lead time refers to the importance placed by the customer on quick delivery.	Challenge in the operating environment: Time-related
4	Length of product lifecycle [product lifecycle duration]	A short product life accentuates the risk of obsolescence.	Challenge in the operating environment: Demand-related
5	Volume of production [demand Volume]	Large production runs can take advantage of economy of scale, whereas small production runs require rapid reconfiguration.	Challenge in the operating environment: Demand-related
6	Supply uncertainty	Raw material supplies to the focal firm may be disrupted by various causes, such as natural disaster, yield losses, quality issues, etc.	Challenge in the operating environment: supply-related
7	Customer service	Customer service refers to the ability to fill rate, the proportion of customer demand that is filled from stock.	performance outcome
8	Contribution margin	When the mark-up on a product is low, there is more emphasis on cost-efficiency of production.	value of market mediation
9	Stage of product lifecycle	The demand for a product changes with the stage of its product lifecycle, the demand at the introduction stage is small and uncertain, but at the mature stage the demand is high and stable.	Challenge in the operating environment: Demand-related
10	Rate of market growth	Rate of market growth changes with the stage of the product lifecycle.	Challenge in the operating environment: Demand-related

11	Complexity of product structure	The bill of material of a product may be simple or complex, with multiple components and subassemblies.	Challenge in the operating environment: supply-related
12	Markdowns	Markdowns occur when prices are reduced because of stocking higher than demand.	value of market mediation
13	Value density	The ratio of product value to product weight.	Challenge in the operating environment: Supply-related
14	Uniqueness	The degree of difficulty in replicating a product by competitors.	value of market mediation

Table 2: Research variables and code

Type of Contingency	Contingency	Code
Demand-related	Demand Variability /uncertainty	CSCS1
	Product Variety	CSCS2
	Length of product lifecycle/Product lifecycle Duration	CSCS3
	Volume of production/Demand Volume	CSCS4
	Rate of market growth	CSCS5
	Stage of product lifecycle	CSCS6
Supply-related	Supply uncertainty	CSCS7
	Complexity of product structure	CSCS8
Time-related	Customer lead time/Delivery time Window	CSCS9
Value of market mediation	Contribution margin	CSCS10
	Markdowns	CSCS11
	Uniqueness	CSCS12
Performance outcome	Customer service/Service level	CSCS13
	Financial performance	CSCS14

Research Methodology

Contingency variables that play a significant role in the formulation of supply chain strategies have been adopted from a literature review paper published by (Basnet & Seuring, 2016) (table 1& table 2). Later opinion from a group of experts having fifteen academicians working in the area of supply chain strategies, in the form of teaching and consultancies and publishing papers in highly reputed journals and associated with reputed institutes in India and eight industry people working at the strategic level in automobile, FMCG and chemical industry and have a role in supply chain strategy formulation for their organisation, have been taken on these variables. A group of experts has been formulated using a snowball sampling technique. On the basis of the opinion of experts, one variable, ‘value density,’ has not been considered in this study. ISM-MICMAC approach has been used to identify the relationship among the variables under study and analyze them on the basis of their driving and dependence power.

Data Collection

A structured questionnaire having ninety-one (14C2) close-ended questions has been used to record the responses of experts. Experts ' responses to each question were recorded in two categories. Firstly, about the existence of a relationship between the variables, and if a relationship exists, then about the direction of the relationship. Researchers personally administrated the questionnaires to the experts.

Interpretive Structural Modelling(ISM)

The ISM is a philosophical approach, first proposed by J. Warfield in 1974 to analyse the complex socioeconomic system (Warfield, 1974; Warfield, 1976; Warfield, 1994). ISM deals with the complex system by analyzing it through systematic, iterative processes and transforming the complex and poorly defined hypothetical system into a hierarchically arranged, more visible model for analytical interpretation (Saxena et al., 2006).

In ISM, a group of experts decides the type of relationship that exists between the elements; after that, through a systematic process, the driving and dependence power of elements are identified, and then a structure is extracted in the form of a digraph model. The steps involved in constructing an ISM (Singh et al., 2014; Srivastava & Sushil, 2013) are as follows:

1. **Identification of Factors:** By extensive literature review, brainstorming sessions, Delphi method, or opinions from academicians and practitioners, identify the factors/elements related to the problem.
2. **Identification of Contextual Relationship:** With the help of expert opinion, identify the contextual relationship among each element with respect to whom pair of elements would be examined.
3. **Development of structural Self-Interaction Matrix (SSIM):** After resolving the factors and contextual relationship, do a pairwise comparison of the factors to create a structural self-interaction matrix.
4. **Preparation of Reachability Matrix:** Prepare the reachability matrix from the SSIM. Transitivity is also considered for the preparation of the final reachability matrix. It states that if factor A determines factor B and factor B determines factor C, then factor A will necessarily determine factor C.
5. **Preparation of Canonical Matrix:** Prepare the canonical matrix format by arranging the factors according to their levels with the help of the reachability matrix.
6. **Development of diagraph**
7. **Removal of transitivity from the diagraph**
8. **Conversion of diagraph to ISM:** Replace the nodes of variables with relationship statements.
9. **Model Review:** Review the model to check for inconsistency. If any inconsistency (ies) is found, then make necessary amendments.

Structural self-interaction matrix (SSIM):

To identify the relationship between the two items, the experts were asked to identify the direction of the relationship between the two enablers. All the pair of factors were selected one by one, and the views of experts were recorded. The four symbols, namely 'V', 'A', 'X' and 'O' have been used to present the directional relationship between contingency variables of supply chain strategy (CSCS) (i (row) and j (column)) (Table 2) using the following rules:

V: Item i will help to determine Item j

A: Item j will help to determine Item i

X: Item i will help to determine Item j and Item j will help to determine Item i

O: Item i and Item j are not related

Table 3: Structural self-interaction matrix (SSIM)

Contingency Variables	CSCS14	CSCS13	CSCS12	CSCS11	CSCS10	CSCS9	CSCS8	CSCS7	CSCS6	CSCS5	CSCS4	CSCS3	CSCS2	CSCS1
CSCS1	V	V	O	O	O	O	O	O	A	O	A	A	A	

CSCS2	V	V	A	O	O	O	O	O	A	O	V	O		
CSCS3	V	V	A	O	O	O	O	O	O	O	O			
CSCS4	V	V	O	O	O	O	O	O	A	O				
CSCS5	V	O	O	O	O	O	O	O	A					
CSCS6	V	V	O	O	V	V	O	O						
CSCS7	V	V	O	O	O	V	O							
CSCS8	V	V	O	O	O	V								
CSCS9	V	V	O	O	O									
CSCS10	V	V	O	A										
CSCS11	V	V	O											
CSCS12	V	V												
CSCS13	V													
CSCS14														

Initial reachability matrix (IRM)

Initial reachability matrix also called binary matrix is derived by substituting the V, A, X and O symbols of SSIM by 0 and 1. Substitution rules are mentioned in table 3.

Table 4: Substitution Rules for Creating IRM from SSIM

IF	Then
the (i, j) entry in the SSIM is V	the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0
the (i, j) entry in the SSIM is A	the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1
the (i, j) entry in the SSIM is X	the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 1
the (i, j) entry in the SSIM is O	the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 0

After incorporating the transitivity the final reachability matrix is shown in table 4.

Table 5: Final reachability matrix

Contingency Variables	**CSCS1**	**CSCS2**	**CSCS3**	**CSCS4**	**CSCS5**	**CSCS6**	**CSCS7**	**CSCS8**	**CSCS9**	**CSCS10**	**CSCS11**	**CSCS12**	**CSCS13**	**CSCS14**
CSCS1	1	0	0	0	0	0	0	0	0	0	0	0	1	1
CSCS2	1	1	0	1	0	0	0	0	0	0	0	0	1	1
CSCS3	1	0	1	0	0	0	0	0	0	0	0	0	1	1
CSCS4	1	0	0	1	0	0	0	0	0	0	0	0	1	1
CSCS5	0	0	0	0	1	0	0	0	0	0	0	0	0	1

CSCS6	1	1	0	1	1	1	0	0	1	1	0	0	1	1
CSCS7	0	0	0	0	0	0	1	0	1	0	0	0	1	1
CSCS8	0	0	0	0	0	0	0	1	1	0	0	0	1	1
CSCS9	0	0	0	0	0	0	0	0	1	0	0	0	1	1
CSCS10	0	0	0	0	0	0	0	0	0	1	0	0	1	1
CSCS11	0	0	0	0	0	0	0	0	0	1	1	0	1	1
CSCS12	0	1	1	0	0	0	0	0	0	0	0	1	1	1
CSCS13	0	0	0	0	0	0	0	0	0	0	0	0	1	1
CSCS14	0	0	0	0	0	0	0	0	0	0	0	0	0	1

3.1.1. Level Partitions

Level Partition was carried out to place the factors level-wise (Warfield, 1974). For level partition the reachability set and antecedent set are created with the help of the final reachability matrix. The reachability set includes interdisciplinary items and others that may be determined; similarly, the antecedent set consists of items themselves and the other items that may help in determining it. Then, the intersection set is derived for all the items. The items for which the intersection and reachability set are the same are levelled. Once the levels are identified, they are separated from the other items. Then the same process is repeated until all items are levelled (Table 5). These levels help build the diagraph or directed graph and the final model.

Table 6: Level of partitions

Iteration I				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS1	1,13,14	1,2,3,4,6	1	
CSCS2	1,2,4,13,14	2,6,12	2	
CSCS3	1,3,13,14	3,12	3	
CSCS4	1,4,13,14	2,4,6	4	
CSCS5	5,14	5,6	5	
CSCS6	1,2,4,5,6,9,10,13,14	6	6	
CSCS7	7,9,13,14	7	7	
CSCS8	8,9,13,14	8	8	
CSCS9	9,13,14	6,7,8,9	9	
CSCS10	10,13,14	6,10,11	10	
CSCS11	10,11,13,14	11	11	
CSCS12	2,3,12,13,14	12	12	
CSCS13	13,14	1,2,3,4,5,6,7,8,9,10,11,12,13	13	
CSCS14	14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	14	**I**
Iteration II				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS1	1,13	1,2,3,4,6	1	
CSCS2	1,2,4,13	2,6,12	2	
CSCS3	1,3,13	3,12	3	

CSCS4	1,4,13	2,4,6	4	
CSCS5	5	5,6	5	**II**
CSCS6	1,2,4,5,6,9,10,13	6	6	
CSCS7	7,9,13	7	7	
CSCS8	8,9,13	8	8	
CSCS9	9,13	6,7,8,9	9	
CSCS10	10,13	6,10,11	10	
CSCS11	10,11,13	11	11	
CSCS12	2,3,12,13	12	12	
CSCS13	13	1,2,3,4,5,6,7,8,9,10,11,12,13	13	**II**
Iteration III				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS1	1	1,2,3,4,6	1	**III**
CSCS2	1,2,4	2,6,12	2	
CSCS3	1,3	3,12	3	
CSCS4	1,4	2,4,6	4	
CSCS6	1,2,4,6,9,10	6	6	
CSCS7	7,9	7	7	
CSCS8	8,9	8	8	
CSCS9	9	6,7,8,9	9	**III**
CSCS10	10	6,10,11	10	**III**
CSCS11	10,11	11	11	
CSCS12	2,3,12	12	12	
Iteration IV				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS2	2,4	2,6,12	2	
CSCS3	3	3,12	3	**IV**
CSCS4	4	2,4,6	4	**IV**
CSCS6	2,4,6	6	6	
CSCS7	7	7	7	**IV**
CSCS8	8	8	8	**IV**
CSCS11	11	11	11	**IV**
CSCS12	2,3,12	12	12	
Iteration V				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS2	2	2,6,12	2	**V**
CSCS6	2,6	6	6	
CSCS12	2,12	12	12	

Iteration VI				
Contingencies	**Reachability Matrix**	**Antecedent Set**	**Intersection Set**	**Level**
CSCS6	6	6	6	**VI**
CSCS12	12	12	12	**VI**

Building the digraph (ISM model)

The ISM hierarchy is the graphical form of the reachability matrix where items are placed in levels and arrows are used to present the directional relationship between them. Finally ISM model is created by removing all transitivity (Figure 1).

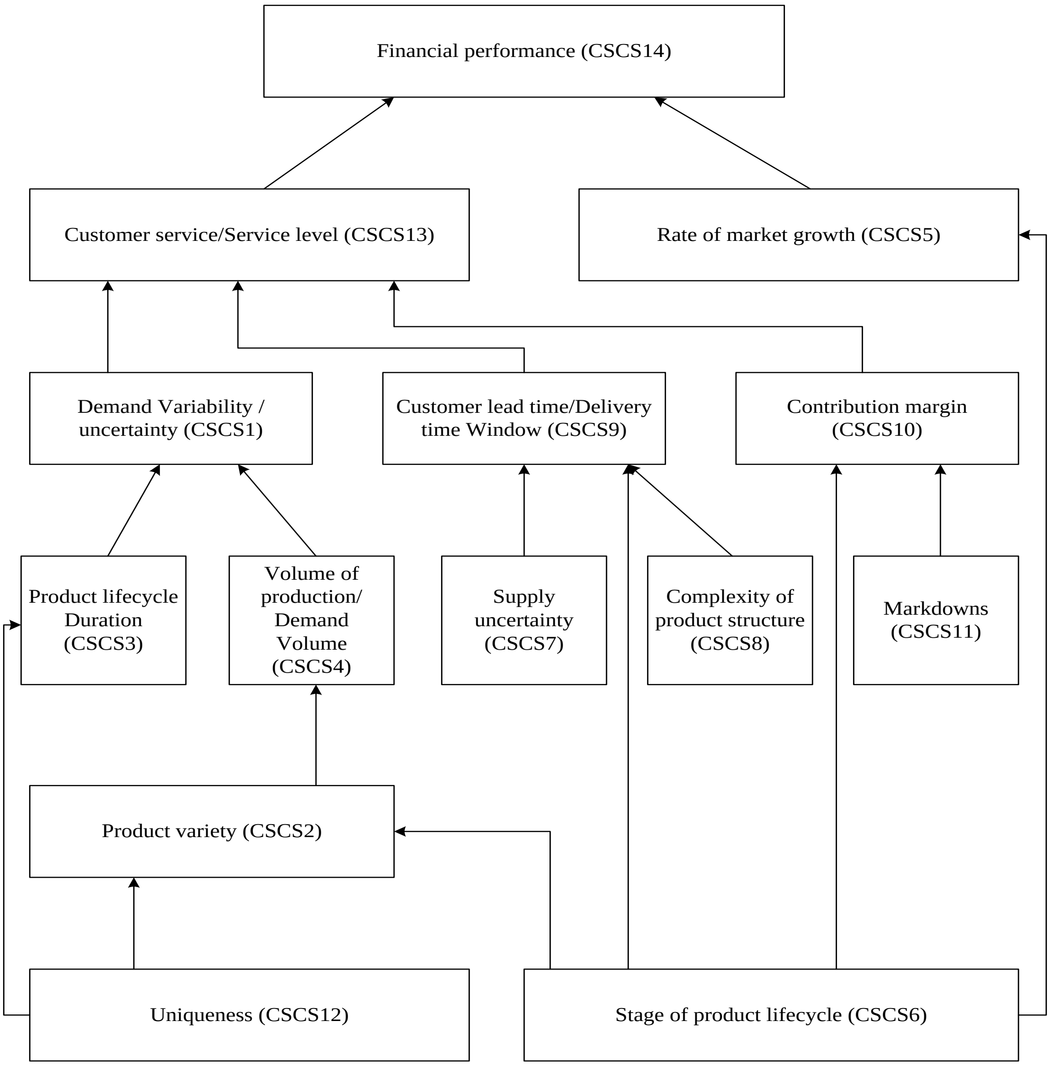

Figure 1: ISM-based model of SCS contingencies

3.3 MICMAC Analysis

For developing the ISM model, an Initial reachability matrix was created that represents the direct binary relationship between the items (Table 4). '1' represents the existence of a relationship, while '0' represents the absence of a relationship between the items. This matrix (Table 4) has been used to calculate the driving and dependence power of items (Table 6). The sum of each row represents the driving power of the respective item, while the sum of each column represents the dependence power of the respective item. The driving power of the research item shows its significance of impact on other items, while dependence power represents the significance of dependency on other items.

Driving and Dependence power values of items, computed in Table 6, have been used for MICMAC analysis where on the basis of these values, items are classified into various groups (Figure 2).

Table 5: Driving and Dependence power of enablers

Contingency Variables	CSCS1	CSCS2	CSCS3	CSCS4	CSCS5	CSCS6	CSCS7	CSCS8	CSCS9	CSCS10	CSCS11	CSCS12	CSCS13	CSCS14	DrP
CSCS1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	3
CSCS2	1	1	0	1	0	0	0	0	0	0	0	0	1	1	5
CSCS3	1	0	1	0	0	0	0	0	0	0	0	0	1	1	4
CSCS4	1	0	0	1	0	0	0	0	0	0	0	0	1	1	4
CSCS5	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
CSCS6	1	1	0	1	1	1	0	0	1	1	0	0	1	1	9
CSCS7	0	0	0	0	0	0	1	0	1	0	0	0	1	1	4
CSCS8	0	0	0	0	0	0	0	1	1	0	0	0	1	1	4
CSCS9	0	0	0	0	0	0	0	0	1	0	0	0	1	1	3
CSCS10	0	0	0	0	0	0	0	0	0	1	0	0	1	1	3
CSCS11	0	0	0	0	0	0	0	0	0	1	1	0	1	1	4
CSCS12	0	1	1	0	0	0	0	0	0	0	0	1	1	1	5
CSCS13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
CSCS14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
DP	**5**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**4**	**3**	**1**	**1**	**12**	**14**	

Note: DP-Dependence Power; DrP-Driving Power

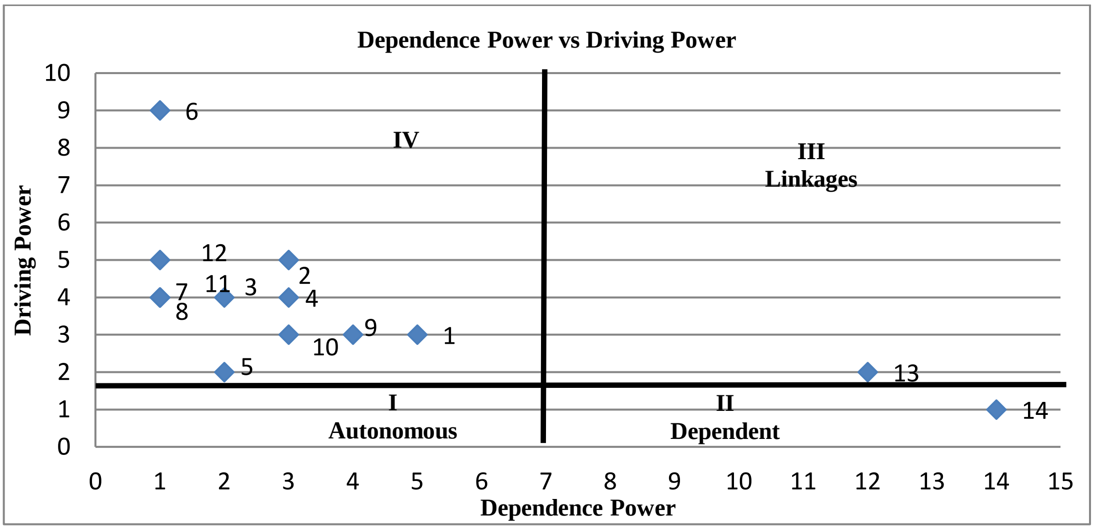

Figure 2: Cluster diagram of SCS contingencies

Key Findings and Discussion

Through extensive literature review and discussion with a group of experts, firstly, this study identifies the fourteen important contingency variables in response to which the configuration of the supply chain takes place. These set of configurations formulate the long-term plan for the supply chain, formally named supply chain strategy. Secondly, the ISM technique has been used to partition the variables into various hierarchy levels (table 6) then the directional relationship between hierarchically arranged contingency variables of supply chain strategies has been displayed by a digraph (figure 2). Analysis of this digraph indicates the importance of 'uniqueness (CSCS12)' and 'stage of the product lifecycle (CSCS6)' as they have occupied the place at the highest level (level VI). Uniqueness directly affects the 'product variety (CSCS2)' and 'product lifecycle duration (CSCS3), which have secured place at level V and level IV, respectively. Contingency variable 'stage of product lifecycle (CSCS6)' directly affects many other contingency variables considered under study like 'product variety (CSCS2)', 'customer lead time/delivery time window (CSCS9)', 'contribution margin (CSCS10)' and 'rate of market growth (CSCS5)' which are paced at various levels in the diagraph. 'Product variety (CSCS2)' affects the 'volume of production/demand volume (CSCS4)' which has occupied space at level IV. 'Product lifecycle duration (CSCS3)', 'volume of production/demand volume (CSCS4)', 'supply uncertainty (CSCS7)', 'complexity of product structure (CSCS8)' and 'markdowns (CSCS11)' variables have secured place at level IV. 'Product lifecycle duration (CSCS3)' and 'volume of production/demand volume (CSCS4)' together determines the 'demand variability/uncertainty (CSCS1)'; 'Supply uncertainty (CSCS7)' and 'complexity of product structure (CSCS8)' determines the 'customer lead time/delivery time window (CSCS9)' and 'markdowns (CSCS11)' is responsible for 'contribution margin (CSCS10)'. All these three contingency variables 'demand variability/uncertainty (CSCS1)', 'customer lead time/delivery time window (CSCS9)' and 'markdowns (CSCS11)' are placed at level III and collectively determines the 'customer service/service level (CSCS13)' which is placed at level II along with another contingency 'rate of market growth (CSCS5)' which is affected by a contingency 'stages of product lifecycle (CSCS6)' placed at level VI. Both of these contingencies (CSCS13 & CSCS5) placed at level II determines the 'financial performance (CSCS14)' of the enterprise.

The next objective of this study was to analyse the driving and dependence power of the research contingencies. This objective has been achieved by using MICMAC technique. MICMAC technique classifies the items into four groups (figure 2) which are as following:

Autonomous Items

Contingency variable that have low driving power and low dependence power belongs to this group. This study has no variable for this class which indicates that all the variables included in this study are important.

Dependent Items

Variables having strong dependence and low driving power are placed in this group. Research variable 'financial performance (CSCS14)' is placed into this group. It indicates the significant dependency of this variable on other variables considered in this study. So management should careful about these factors because changes in this variable occur mainly due to changes in rest of the factors considered is this study.

Linkage Items

Contingencies that have strong driving power as well as strong dependence power are placed into this group. One variable 'customer service/service level (CSCS13)' is placed into this group which indicates that it is the most sensitive variable among all the variables considered for this study. Management should very careful about this variable because any changes in system will affect this item and vice versa.

Independent Items

Variables that have high driving power and low dependence power are placed into this group. Twelve contingencies 'Demand Variability /uncertainty (CSCS1)', 'Product Variety (CSCS2)', 'Length of product lifecycle/Product lifecycle Duration (CSCS3)', 'Volume of production/Demand Volume (CSCS4)', 'Rate of market growth (CSCS5)', 'Stage of product lifecycle (CSCS6)', 'Supply uncertainty (CSCS7)', 'Complexity of product structure (CSCS8)', 'Customer lead time/Delivery time Window (CSCS9)', 'Contribution margin (CSCS10)', 'Markdowns (CSCS11)' and 'Uniqueness (CSCS12)' have secured place in this group. Changes in these items will bring change in other variables and system.

Conclusion and future research scope

This study is an effort to identify the relationship among contingencies for which supply chains are configured. Study helps in understanding the interdependency cause and effect relationship) among contingency variables and identifies the root contingencies. The idea behind this study was to consider the 'root cause variable(s)' in the formulation of supply chain strategy instead of considering the 'effect variables'. This helps in reducing the complexity of supply chain strategies and enhancing the performance of supply chain by providing few non-trivial root contingencies. For this purpose firstly research adopts 14 critical contingency variables. Secondly, with the help of structured questionnaire data from the experts has been collected for establishing and presenting the directional relationship among research items. For this purpose ISM technique has been used which results into a diagraph (figure 1). Product variety, uniqueness, stages of product lifecycle, supply chain uncertainty, complexity of product structure and markdown are the root contingencies and rest of the variables considered in this study are the direct or indirect effect of these variables. Thirdly, driving and dependence power of the research items are analysed with the help of integrated ISM-MICMAC analysis. This analysis places the research variables into four groups.

Any possible bias in this research can provide scope for future research. Relationship between the items has not been assigned weight this could be done with the help of structural equation modelling (SEM). Instead of MICMAC analysis fuzzy MICMAC analysis could be used for more precise result.

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