

An Interpretive Structure Model Approach to supply chain flexibility: A Case study of Indian FMCG firm

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Abstract- The current business environment is becoming increasingly uncertain, unpredictable and turbulent. Organizations always keep themselves ready to face any eventuality. Flexibility is one of the ways to cope up with uncertainty. Supply chain flexibility refers to the ability to change the supply chain system as per the current business need. The purpose of this paper is to identify dimensions of supply chain flexibility, fit in the environment of Indian FMCG firm. Dimensions of supply chain flexibility are extracted from literature after extensive literature review. A field survey is conducted to interview experts of the case firm and then a questionnaire survey was done to collect responses. Total 23 senior and middle level managers participated in the interview session to give their valuable insights and same no. of executives' participated in questionnaire survey. The data collected from case firm was used as an input develop interpretive structural model. In this study 22 dimensions of supply chain flexibility are extracted from literature.

Key Words: Supply chain, Interpretive structure modelling, Flexibility, FMCG

Introduction

Current business environment is highly uncertain and unpredictable, that prompted firms to adopt flexibility in its operational environment. Supply chain flexibility is essential to cope up and to provide optimal solution of uncertain behavior: uncertain demand, ever changing government rules, uncertain availability of suppliers etc. The highly volatile and dynamic nature of the contemporary business environment forces many distributive firms to make adaptations in channel relationships and to modify the rules of exchange as circumstances change (Sezen and Yilmaz, 2007). *Flexibility may be defined as the ability to change or react with little penalty in time, effort, cost or performance* (Upton, 1994).

In the present study authors have extracted 22 supply chain flexibility dimensions after extensive literature review and after field visit authors have reduced the dimensions from 22 to 12 after field visit. Authors have visited various organizations related to personal hygiene industry for data collection and brain storming session.

Indian Personal Hygiene Industry: An Overview

The Indian personal hygiene sector is dominated by multinational companies (MNCs) which have been operating in the country for a number of years. Personal Hygiene market consists of toiletries, bath soaps, deodorant and shower products. Personal hygiene products, such as soaps, shampoos, conditioners etc is daily use product for everyone.

The Indian personal hygiene market had total revenues of \$2,229.1m in 2012, representing a compound annual growth rate (CAGR) of 12.4% between 2008 and 2012. Market consumption volumes increased with a CAGR of 6.8% between 2008 and 2012, to reach a total of 6,336 million units in 2012. The market's volume is expected to rise to 8,479.5 million units by the end

of 2017, representing a CAGR of 6.0% for the 2012-2017 periods. [Source: MARKETLINE Survey, 2013]

Identification and description of supply chain flexibilities

Dimensions of flexibility are extracted from existing literature for developing flexible supply chain paradigm in firms belongs to Indian personal Hygiene industry. Some of the dimensions here seem to be overlapped or have similar meaning, but here clear distinction among various flexibility dimensions has been proposed by various researchers in earlier studies in the context of supply chain flexibility. In the present study, only those papers have been considered that are indexed in Scopus and Google scholar.

| S.No. | Dimension | Description | Author(s) |
|-------|--|--|--|
| 1 | Product | Ability to produce products characterised by numerous features, options, sizes, and colours | Sánchez and Pérez (2005), Kumar et al. (2006), Parker & Wirth (1999), Vickery et al. (1999), Stevenson and Spring (2007) |
| 2 | Volume | Ability to produce above/below the installed capacity for a product | Sánchez and Pérez (2005), Stevenson and Spring (2007), Parker & Wirth (1999), Vickery et al. (1999) |
| 3 | Transshipment | ability to transfer the products among stocking locations | Sánchez and Pérez (2005) |
| 4 | New product development/ Launch Flexibility | Ability to introduce new products with new features and new style | Kumar et al. (2007), Kumar et al. (2006), Vickery et al. (1999), Ndubisi et al. (2005), Sánchez and Pérez (2005) |
| 5 | Sourcing | Ability to have multiple suppliers for one product | Kumar et al. (2007), Sánchez and Pérez (2005), Kumar et al. (2006), Candace et al. (2011) |
| 6 | Physical Distribution Flexibility | Ability to change distribution processes | Yu et al. (2012), Zhang et al. (2002, 2005), Vickery et al. (1999), Cooper et al. (1997), Lambert et al. (1998) |
| 7 | Demand Management Flexibility | ability to enhance its responsiveness by satisfying the variety of customer needs for service, delivery time, and price (Zhang et al., 2002) | Yu et al. (2012), Zhang et al. (2002), Lee (2001), |
| 8 | Coordination Flexibility | Ability to develop of relationship management processes between | Yu et al. (2012), Wilson and Platts (2010) |

| | | | |
|----|-----------------------|---|--|
| | | partners through integrative capabilities (Sezen and yimlaz,2007) | |
| 9 | Logistics | ability of a firm to respond quickly and efficiently to changing customer needs in inbound and outbound delivery, support, and services (Zhang, 2005) | Cunningham (1996), Kumar et al. (2007), Sa´nchez and Pe´rez (2005), Zhang et al. (2005), Stevenson and Spring (2007) |
| 10 | Manufacturing | Ability to change levels of production, to develop new products more quickly | Slack (1983,1987), Kathuria (1998), Kumar et al. (2007), Oke (2005), Yazici(2005) |
| 11 | Information System | ability of an organization’s collective information system to adapt and support changing requirements of the business functions (Kumar et al.,2008) | Kumar et al. (2007), Stevenson and Spring (2007) |
| 12 | Routing | Ability to vary the path, a product may take through the manufacturing system. | Parker & Wirth (1999), Sa´nchez and Pe´rez (2005) , Stevenson and Spring (2007) |
| 13 | Delivery | Ability to fix the delivery of product as per customer’s wish and adjust the lead time accordingly | Sa´nchez and Pe´rez (2005), Kumar et al. (2006), Stevenson and Spring (2007) |
| 14 | Respond to market | Ability to respond quickly to the need of market | Vickery et al. (1999), Sa´nchez and Pe´rez (2005), Kumar et al. (2006) |
| 15 | Access | ability to provide a widespread or intensive distribution coverage, | Sa´nchez and Pe´rez (2005), Hua et al. (2009) |
| 16 | Postponement | Ability to keep the product in its original form till the delivery. | Sa´nchez and Pe´rez (2005) |
| 17 | Process | Ability of producing different kind of products using the same facilities in production system | Parker & Wirth (1999), Sa´nchez and Pe´rez (2005), Stevenson and Spring (2007) |
| 18 | Operation | ability to produce a product in different ways | Parker & Wirth (1999), Stevenson and Spring (2007), Candace et al (2011) |
| 19 | Expansion Flexibility | ability to expand the capacity of the system | Parker and Wirth (1999), Stevenson and Spring (2007) |
| 20 | Machine | Ability of a machine to perform various tasks | Suarez et al. (1996), Parker and Wirth (1999), Mohamed et al. (2001), Lummus (2003), |

| | | | |
|----|-------------------|---|--|
| | | | Stevenson and spring (2007) |
| 21 | Labour | Ability to assign varying number of operators as needed | Karuppan (2004), Lummus (2003), yazici (2005) |
| 22 | Material handling | ability to move the product in different ways within a manufacturing facility | Lummus et al. (2003), Suarez (1996), kara and Kayis (2004) |

Data Collection- data collection for this study has been done in two phases

Phase 1- data collection to find out the supply chain flexibility dimensions, having significant impact on firm performance

Phase 2- Data collection for ISM Methodology

Table 2: Executive details participated in interview/questionnaire survey

| Professionals From Industry/ Academics | Participation in Expert Interview |
|--|-----------------------------------|
| General Manager | 1 |
| Plant Manager | 5 |
| Procurement Manager | 5 |
| Quality Control | 2 |
| ERP Manager | 2 |
| Logistic Controller | 1 |
| Engineer (Product Division) | 4 |
| Manager (Distribution) | 1 |
| Marketing Manager | 2 |
| Industry Total | 23 |
| Academic/Researcher | 3 |
| Grand Total | 26 |
| Experience Range | 03-28 years |

After interaction with industry experts, only those flexibility dimensions, having significant impact on supply chain performance of firm are taken into consideration for further calculations i.e. coordination, volume, Physical distribution, sourcing, new product, demand management, Product, manufacturing, respond to market, process and expansion flexibility dimension of supply chain

ISM Methodology

Interpretive structural modelling (ISM) is a well-established methodology for identifying and summarizing relationships among specific items which define an issue or problem. It provides a means by which a group can impose order on the complexity of the items (Mandal and Deshmukh, 1994)

According to Gupta and Acharya (2013) It is called, interpretive because the judgment of the experts decides whether the elements/factors are inter-related. This important tool has been used in the present study so as to take long-term strategic decisions with regard to lean manufacturing implementation. ISM clearly identifies the factors which are required to be controlled in order to make strategic decisions for developing lean environment. It also describes the important indicators for lean performance in long-term scenario. ISM methodology suggests the use of the

experts' opinions based on various management techniques such as brain storming, nominal technique, etc. in developing contextual relationship in a case-based study among the variables (Mohammed et al., 2008). Use of ISM in hierarchical modeling have also been recommended and employed by Mohammed et al. (2008), Mandal and Deshmukh (1994) and Saxena et al. (1992). The steps taken to achieve appropriate type of relationship are mentioned in next subsection.

A questionnaire was designed consisting of factors identified from the literature and a group of experts of soap manufacturing industry were approached for their feedback along with brainstorming session at length. A total of 26 experts belonging to major departments of the firm and expert from academia participated in the study whose experience ranges from 3years to 28 years.

VAXO Matrix

V – determinant i will help to attain determinant j;

A – determinant j will help to attain determinant i;

X – determinant i and j will help to attain each other; and

O – determinant i and j are not related.

| Factor No. | Factor Name | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
|------------|-------------------------|----|----|---|---|---|---|---|---|---|---|
| 1 | Product | V | O | A | V | V | V | O | V | V | V |
| 2 | Physical Distribution | V | A | A | O | V | V | O | X | X | X |
| 3 | Expansion | V | A | O | V | V | O | O | V | X | |
| 4 | Volume | V | V | O | A | V | O | V | X | | |
| 5 | Process | A | O | O | V | X | O | X | | | |
| 6 | New Product development | V | O | O | V | A | X | | | | |
| 7 | manufacturing | A | O | O | V | X | | | | | |
| 8 | coordination | O | O | A | X | | | | | | |
| 9 | Demand management | O | O | X | | | | | | | |
| 10 | Market | A | X | | | | | | | | |
| 11 | Sourcing | X | | | | | | | | | |

INITIAL SSIM

| Factor No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|------------|---|---|---|---|---|---|---|---|---|----|----|
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 4 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 5 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |

| | | | | | | | | | | | | |
|----|---|---|---|---|---|---|---|---|---|---|---|--|
| 7 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | |
| 8 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| 9 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | |
| 10 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| 11 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | |

Transitivity Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Driving Power |
|------------------|----------|----------|----------|-----------|----------|----------|-----------|-----------|----------|----------|-----------|---------------|
| 1 | 1 | 1 | 1 | 1 | 1* | 1 | 1 | 1 | 0 | 1* | 1 | 10 |
| 2 | 0 | 1 | 1 | 1 | 1* | 1 | 1 | 1* | 0 | 1* | 1 | 9 |
| 3 | 0 | 1 | 1 | 1 | 1* | 1* | 1 | 1 | 0 | 1* | 1 | 9 |
| 4 | 0 | 1 | 1* | 1 | 1 | 1* | 1 | 1* | 0 | 1 | 1 | 10 |
| 5 | 0 | 0 | 0 | 1* | 1 | 0 | 1 | 1 | 0 | 0 | 1* | 5 |
| 6 | 0 | 0 | 0 | 1* | 1* | 1 | 1* | 1 | 0 | 1* | 1 | 7 |
| 7 | 0 | 0 | 0 | 1* | 1 | 1 | 1 | 1 | 0 | 0 | 1* | 6 |
| 8 | 0 | 1* | 0 | 1 | 1* | 0 | 1* | 1 | 0 | 1* | 1* | 7 |
| 9 | 1 | 1 | 1* | 1* | 0 | 1* | 1* | 1 | 1 | 0 | 1* | 9 |
| 10 | 0 | 1 | 1 | 1* | 0 | 1* | 1* | 1* | 0 | 1 | 1* | 8 |
| 11 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1* | 0 | 1 | 1 | 5 |
| Dependence Power | 2 | 7 | 6 | 10 | 9 | 8 | 11 | 11 | 1 | 8 | 11 | |

| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|-----------------------|-------------------------|------------------|----------|
| 1 | 1,2,3,4,5,6,7,8,10,11 | 1,9 | 1 | |
| 2 | 2,3,4,5,6,7,8,10,11 | 1,2,3,4,8,9,10 | 2,3,4,8,10 | |
| 3 | 2,3,4,5,6,7,8,10,11 | 1,2,3,4,9,10 | 2,3,4,10 | |
| 4 | 2,3,4,5,6,7,8,10,11 | 1,2,3,4,5,6,7,8,9,10 | 2,3,4,5,6,7,8,10 | |
| 5 | 4,5,7,8,11 | 1,2,3,4,5,6,7,8,11 | 4,5,7,8,11 | I |
| 6 | 4,5,6,7,8,10,11 | 1,2,3,4,6,7,9,10 | 4,6,7,10 | |
| 7 | 4,5,6,7,8,11 | 1,2,3,4,5,6,7,8,9,10,11 | 4,5,6,7,8,11 | I |
| 8 | 2,4,5,7,8,10,11 | 1,2,3,4,5,6,7,8,9,10,11 | 2,4,5,7,8,10,11 | |
| 9 | 1,2,3,4,6,7,8,9,11 | 9 | 9 | |
| 10 | 2,3,4,6,7,8,10,11 | 1,2,3,4,6,8,10,11 | 2,3,4,6,8,10,11 | |
| 11 | 5,7,8,10,11 | 1,2,3,4,5,6,7,8,9,10,11 | 5,7,8,10,11 | I |

| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|------------------|-------------------------|--------------|-----------|
| 1 | 1,2,3,4,6,8,10 | 1,9 | 1 | |
| 2 | 2,3,4,6,8,10 | 1,2,3,4,8,9,10 | 2,3,4,8,10 | |
| 3 | 2,3,4,6,8,10 | 1,2,3,4,9,10 | 2,3,4,10 | |
| 4 | 2,3,4,6,8,10 | 1,2,3,4,6,8,9,10 | 2,3,4,6,8,10 | II |
| 6 | 4,6,8,10 | 1,2,3,4,6,9,10 | 4,6,10 | |
| 8 | 2,4,8,10 | 1,2,3,4,5,6,7,8,9,10,11 | 2,4,8,10 | |
| 9 | 1,2,3,4,6,8,9 | 9 | 9 | |
| 10 | 2,3,4,6,8,10 | 1,2,3,4,6,8,10,11,12 | 2,3,4,6,8,10 | II |

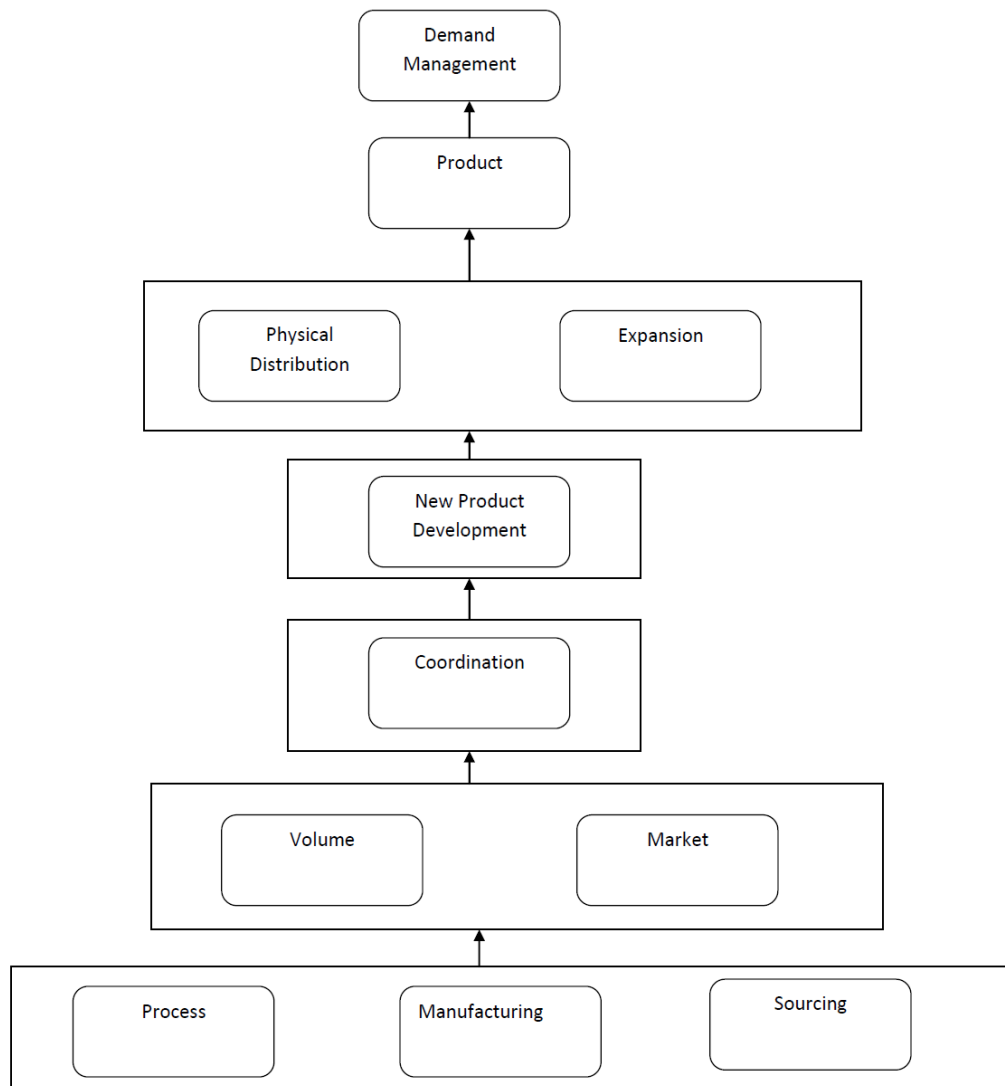
| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|------------------|--------------------|--------------|------------|
| 1 | 1,2,3,6,8 | 1,9 | 1 | |
| 2 | 2,3,6,8 | 1,2,3,8,9 | 2,3,8 | |
| 3 | 2,3,6,8 | 1,2,3,9 | 2,3 | |
| 6 | 6,8 | 1,2,3,6,9 | 6 | |
| 8 | 2,8 | 1,2,3,5,6,7,8,9,11 | 2,8 | III |
| 9 | 1,2,3,6,8,9 | 9 | 9 | |

| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|------------------|----------------|--------------|-----------|
| 1 | 1,2,3,6 | 1,9 | 1 | |
| 2 | 2,3,6 | 1,2,3,9 | 2,3 | |
| 3 | 2,3,6 | 1,2,3,9 | 2,3 | |
| 6 | 6 | 1,2,3,6,9 | 6 | IV |
| 9 | 1,2,3,6,9 | 9 | 9 | |

| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|------------------|----------------|--------------|----------|
| 1 | 1,2,3 | 1,9 | 1 | |
| 2 | 2,3 | 1,2,3,9 | 2,3 | V |
| 3 | 2,3 | 1,2,3,9 | 2,3 | V |
| 9 | 1,2,3,9 | 9 | 9 | |

| Factors | Reachability Set | Antecedent Set | Intersection | Level |
|---------|------------------|----------------|--------------|------------|
| 1 | 1 | 1,9 | 1 | VI |
| 9 | 1,9 | 9 | 9 | VII |

| FACTOR NO | LEVEL |
|-----------|-------|
| 5,7,11 | I |
| 4,10 | II |
| 8 | III |
| 6 | IV |
| 2,3 | V |
| 1 | VI |
| 9 | VII |



Discussion and conclusion

The main objective of ISM is to analyze the driver power and the dependency of the variables (Mandal and Deshmukh, 1994). After our analysis, it can be seen that demand management comes out as prominent factor. Demand Management is the ability to enhance its responsiveness by satisfying the variety of customer needs for service, delivery time, and price. Ultimately firms work to satisfy customer demand only, so no surprise, it comes at top in the hierarchy.

The ultimate objective of any supply chain is to attain customer satisfaction, and the concept of flexibility comes to achieve the same (Singh and Acharya, 2013). According to Gupta and Acharya (2013) Major contribution of ISM model is the hierarchical interaction among the Supply chain flexibility dimension of a soap manufacturing firm. It identifies the level of hierarchy and inter-relationship of the factors which help the strategic managers to take actions in order to improve the performance of their organization

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