# Assessment of supply chain agility in the Indian garment industry

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**ABSTRACT**

The research aims to provide a supply chain agility framework with stage-wise holistic assessment of the performance and binding relationships. The study considers agility at three stages: supply, manufacturing, and distribution. It applies structural equation modelling to examine the impact of major determinants as strategic partnership, information sharing, resilience, sourcing flexibility, and order fulfillment flexibility on stage-wise agility in the supply chain. The analysis has uncovered that manufacturing agility is affected by all the determinants while supply agility is not affected by any constructs of flexibility of sourcing and order fulfillment in the Indian garment industry. Distribution agility is significantly affected by all the determinants but information sharing and resilience, which can be caused by infrastructure constraints in the Indian conditions. The research provides important implications for practitioners and researchers.

**Contribution/ Originality**

This research contributes to the academia and industry. It considers the vague explanation of supply chain agility and holistically describes it in the segregated stage-wise approach. It builds on gaps in the literature about the assessment of supply chain agility at individual stages of supply chain. The paper produces a comprehensive framework for the stage-wise investigation of agility within the impactful determinant interactions. It investigates the hypothesized relationships that do not prove statistically feasible.

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## 1. INTRODUCTION

Agility is the most crucial element of the 'triple A' supply chain (along with adaptability and alignment) which focuses on a quick response to short-term changes in demand or supply and smooth handling of external disruptions (Lee, 2004). Lee has emphasized that mere efficiency is not enough and all great supply chains are agile. Supply chain agility is more important in situations of demand uncertainty, high perishability of products, and low life cycles (Fisher, 1997; Christopher, 2000; Lee, 2002). Garment products face high demand fluctuations and uncertainties because of consistent changes in the fashion that make demand forecasting really challenging (Sheffi, 2005). High uncertainty in the market and consumer tastes reduces the life cycle of garment products and makes them perishable irrespective of their material life cycles. Fast fashion retailers like Zara and H&M consistently introduce new designs and renew their product ranges every 2-3 weeks at reasonable prices (Barnes and Lea-Greenwood, 2006; Bianchi and Birtwistle, 2012). That increases consumption and consumers' expectation of frequent changes and availability of new products (Bruce and Daly, 2006) resulting in a reduced life cycle of garment products and making them highly perishable.

In India the garment and textiles industry contributes 5% of Indian GDP and 11% to the country's overall Index of Industrial Production (IIP). However, the garment and textile industry in India is highly fragmented and competition is very intense on the domestic and international markets. Domestic garment organizations earn good margins, although for being market leaders their supply chains need to be more responsive (CRISIL Research, 2015). This paper focuses on studying the agility of chain supplies in the Indian garment industry. The study explores how supply chain agility in the garment industry works and how it is influenced over time. Irrespective of its size and contribution to the Indian economy the garment industry has failed to grab the attention of researchers of supply chain management. Literature survey shows lack of studies on the garment supply chain in India and supply chain agility in the Indian context. The only literature on the Indian garment industry we found is related to the productivity of Indian apparel manufacturers (Bheda *et al.*, 2003; Joshi and Singh, 2010), export performance of the garment and textiles industry (Balasubramanyam and Wei, 2005; Bhavani and Tendulkar, 2001), lean manufacturing practice in the textile industry in southern India (Saleeshya and Raghuram, 2012), corporate social responsibility and working conditions in the Indian garment industry (Stigzelius and Mark-Herbert, 2009; de Neve, 2009), social and environmental disclosure practices (Nurhayati *et al.*, 2015), and technical efficiency in the Indian textiles industry (Bhandari and Ray, 2012).

Lack of studies of the garment supply chain and its responsiveness provides motivation for studying the supply chain which focuses on the garment industry. It motivates to explore the general supply chain structure which can affect the supply chain agility in India. Previous studies cover: alignment and dissimilarities in supply chain management practices (Sahay *et al.*, 2006; Jharkharia and Shankar, 2006; Sahay and Mohan, 2003), supply chain architecture in India (Sahay *et al.*, 2003), information system (Rahman, 2004) and supply chain performance measurement (Saad and Patel, 2006). Studies reveal that Indian supply chain infrastructure is inadequate to meet growth aspirations and faces many challenges that affect its responsiveness such as: connectivity issues, congested roads and ports, high cost, lower profitability, inadequate manpower resources, and lower technology adoption (Gupta *et al.*, 2010; Jayaram and Avittathur, 2012; Deloitte, 2014).

This study addresses the following research questions to bridge the aforementioned gaps in research: 1. what are the key determinants of an agile performance of the supply chain 2. how to assess supply chain agility in the Indian garment industry.

The research aims to conceptualize and validate the various construct affecting supply chain agility in the garment industry. The research considers the Indian context and develops a holistic measure of supply chain agility for practitioners and future research in the area. In the following sections the research describes the conceptual background to the agile supply chain and its determinants followed

by the theoretical framework and the proposed hypothesis. The study uses structural equation modeling for data analysis followed by discussion of the results and managerial implications of the research.

## 2. LITERATURE REVIEW

An agile supply chain focuses on rapidly adapting to changes of customers' needs and market volatility (Roh *et al*., 2014). The philosophy of agility resides in the existence of uncertain situations and focuses on faster response to the requirements of the market (Mahadevan, 2015). Time reduction improves agility and enables the supply chain to deliver the right product in the right quantity to the right customers/destinations in the desired time. Agility in the supply chain (Christopher, 2000; Chopra and Meindl, 2007) is a major aspect of a responsive supply chain. A responsive supply chain additionally inherits the cost consideration that enables a quick reaction with cost efficiency to cope with the changing market requirements in a competitive environment (Gunasekaran *et al*., 2008).

Agility is dependent on the efforts of all partners across the supply chain (Kim *et al*., 2006). It therefore requires the effort of the entire supply chain to effectively respond to customer demands and environmental challenges (Mentzer *et al*., 2001; Burke and Vakharia, 2002; Kim and Lee, 2010). There are 3 main stages in any supply chain: sourcing, manufacturing, and delivery. For fast responsiveness there should be equal contribution from all three stages of the supply chain. Overall responsiveness will be portrayed at the supplier, manufacturer, flow, and delivery. There are studies on the individual aspects of responsiveness.

There is plenty of research that focuses on supplier responsiveness, factors that cause it, and the impact of suppliers on the responsiveness of the whole supply chain (Sinkovics *et al*., 2011; Martin and Grbac, 2003; Williamson, 1991; Squire *et al*., 2009). Attention has likewise been paid to manufacturing agility (Godsell *et al*., 2006; Gunasekaran *et al*., 2008; Kim *et al*., 2013; Wong and Hvolby, 2007; Seth and Panigrahi, 2015). The final phase of agility resides in distribution and delivery of the supply chain which focuses on the flow of finished products. It has been termed *distribution agility* in research. Distribution agility is the final level which oversees the shipment and delivery of the finished products to retailers and customers. Very few studies describe the importance of distribution and logistical agility of a supply chain. Among the major contributions, Vidalakis and Sommerville (2013) measure the relationship between transportation responsiveness and cost efficiency to analyze the delivery performance and transport efficiency in the supply chain. Ülgen and Forslund (2015) identify the supply chain practices and barriers to the management of logistical performance in the textile industry. This paper divides agility into three stages: supply agility, manufacturing agility, and distribution agility. All three stages have been simultaneously covered in the study to paint the complete picture of supply chain agility.

### 2.1. Supply agility
Supply agility examines the response of suppliers to the manufacturers. The manufacturer requires the suppliers' agility in the procurement, sourcing and support related activities. Sinkovics *et al*. (2011) describe the different factors of supply agility and emphasized the importance of the supplier responsiveness in meeting the customer demands quickly worldwide and increasing overall supply chain responsiveness. Current research includes the constructs of supply agility based on: coping with fluctuations and variations in the demand, suppliers' inventory level adequacy to fulfill the emergency orders and increased orders, and suppliers' responsive approach towards replacement of the defective items.

### 2.2. Manufacturing agility
Manufacturing agility is the major part of the overall supply chain agility. It covers the activities at the manufacturer's end in order to procure, make and deliver the right product to the right customer in the right quantity and within the given time. In the garment industry where the product life cycle is low and the rate of obsolescence is very high, manufacturing agility is very crucial to any garment

manufacturing firm. In the current research, the constructs which have been considered for manufacturing agility include: production planning, optimum inventory and continuous flow of inventory at the retailers' end and immediate response to the retailers' or customers' demands (Godsell *et al*., 2006; Gunasekaran *et al*., 2008).

### 2.3. Distribution agility

Distribution agility takes into account the variables which are crucial for the flow of items (mainly the finished products) from one place to another. Specifically, distribution focuses on the key logistics activities such as: movement and storage of goods from one location to another (Jacobs and Chase, 2008). Having their significant effect on firm performance the logistics activities aim at delivering the right product to the customers at right time (Goetschalckx, 2011). The supply chain performance very much depends upon the performance of the distribution agility. Any delays caused in the distribution will delay the delivery performance of the supply chain (Ülgen and Forslund 2015).

### 2.4. Determinants of supply chain agility

An agile supply chain aims at fulfilling the maximum customer demands with no loss on sales. However, the agility of the supply chain depends upon its determinants and their impact on its performance. Determinants of agility (François *et al*., 2010) are the determining factors of its process which impacts the performance of the entire supply chain. Determinants are independent factors or variables which drastically affect the performance of a dependent factor or variable. A variation in the usual behaviour of determinants will certainly cause the variation in agility and thus, a variation in the entire supply chain performance. The paper aims at determining the basic factors that influence the behaviour of a supply chain. A complete picture of overall supply chain agility requires the portrayal of both the upstream supply chain and the downstream supply chain.

Lee (2004) has, described adaptability and alignment as the major elements required for the survival of the modern supply chain. Adaptability refers to the flexibility of a supply chain to adjust with the changes and the structural shifts happening in the market. Alignment focuses on strategic alliances in upstream and downstream supply chain by information sharing, partnership building and risk sharing (Simchi-Levi *et al*., 2008; Lee, 2004). Hence, the basic aspects of a supply chain's responsive performance include: information system (Qrunfleh and Qrunfleh, 2014), flexibility (Kim *et al*., 2013), uncertainty (Hult *et al*., 2010) and partnerships (Montoya-Torres and Ortiz-Vargas, 2014). Long term strategic partnerships resulting from the continuous information sharing result in the improved supply chain performance. Information sharing in the supply chain improves visibility (Williams *et al*., 2013). Improved visibility enhances supply chain agility (Brusset, 2016).

Uncertainties in the supply chain make it vulnerable to the disruptions (Sheffi, 2005). A supply chain requires a resilient approach to overcome its vulnerabilities and uncertainties (Sheffi, 2005; Kamalahmadi and Parast, 2016). Flexibility is important in both upward and downward ends of the supply chain. Flexibility in the upstream supply chain improves the availability of the qualified materials & services and improves the purchasing efficiency to respond to the changing requirements (Moon *et al*., 2012). Flexibility in the downstream supply chain which is involved in the order fulfillment process represents the manufacturing flexibility, the operating system flexibility and the distribution flexibility (Moon *et al*., 2012; Kim *et al*., 2013). The paper introduces the major determinants of the agile supply chain as a strategic partnership, information sharing, resilience, sourcing flexibility and order fulfillment flexibility.

### 2.5. Strategic partnership

Strategic partnership in the supply chain is important for all the members of a value chain irrespective of their size, function or the relative position (Horvath, 2001). The organizations involved in strategic partnership with their suppliers and customers become able to - integrate their supply and demand, improve their supply chain performance, get benefitted from the close

relationships and generate more opportunities for better improvements (Barratt, 2004). More collaborative practices result in better firm performance leading to the supply chain responsiveness. Organizations with no strategic collaboration combined with isolated forecasting and planning - face the situations of disconnection between supply and demand, and overstocking of inventory in upward and downward supply chain.

## 2.6. Information sharing

Information sharing aims at collecting and sharing the real time information among the members of the supply chain. It enhances the supply chain visibility which is the extent to which the supply chain members share or have the access to information useful to the operations and mutual benefits (Barratt and Oke, 2007). Information sharing is required in every phase of the supply chain and it can play a significant role in all the three aspects of responsiveness – logistics responsiveness, supplier responsiveness and downstream responsiveness.

## 2.7. Resilience

Resilience refers to a firm's capability to survive, adapt and grow in a dynamic, changing and uncertain environment (Fiksel, 2006; Sawik, 2013). The concept of resilience refers to its capability of returning back to the stable state after facing the disruptive situation. Disruptions in the supply chain are inevitable. The literature mainly focuses on two kinds of approaches to the resilience i.e. proactive approach and reactive approach (Melnyk *et al*., 2014). Reactive approach comes into action after the disruption has taken place, while proactive approach refers to the preparedness. However, an agile supply chain needs to focus on proactive approach in the wake of upcoming disruptions. A reactive approach will be associated with the recovery process after the disruption occurrence, which will reduce the responsiveness. In this paper resilience will mainly concentrate on the proactive approach.

## 2.8. Sourcing flexibility

Sourcing flexibility refers to the flexibility of the supply side to vary manufacturing orders and demands. Sourcing flexibility is a supply chain reconfiguration ability through selection and de-selection of the vendors (Gosling *et al*., 2010). It can be perceived as an adaptive response to the uncertainty in upstream supply chain environment (Gerwin, 1993). Sourcing flexibility is directly associated with the responsiveness of the manufacturer and the study assumes that it affects all the three forms of responsiveness.

## 2.9. Order fulfilment flexibility

Order fulfilment flexibility refers to the flexibility in the downstream supply chain which begins from the manufacturer. Order fulfilment flexibility aims at providing faster responses in the downstream supply chain. It focuses on the flexibility in the processes and flexibility in the demand fulfilment (Tang and Tomlin, 2008). Flexibility in processes indicates to the manufacturing flexibility which emphasizes on the shifting of the production quantities across the internal resources and the demand fulfilment flexibility involves shifting the production quantities across different products as well as shifting demands across different products including postponement and flexible pricing (Tang and Tomlin, 2008).

## 2.10. Theoretical framework and hypothesis

The theoretical framework (See figure 1) conceptualizes the assessment of agility at different stages of the supply chain and its response to the various supply chain determinants. However, the assessment of agility framework is quite challenging because of several reasons. There are not many studies that have covered individual stages for the assessment of agility. A holistic approach for the supply chain assessment in developing economies is still required and the Indian context is yet to receive full-fledged attention to supply chain researchers. The existing studies do not deal agility and most of the supply chain studies in India context are of an exploratory nature. The current theoretical framework proposes the hypothetical relationship between various determinants – strategic

partnership, information sharing, resilience, sourcing flexibility, order fulfilment flexibility and the stages of agility i.e. supply agility, manufacturing agility and distribution agility. The study proposes following hypothesis:

H1: Supply agility as a dimension of supply chain agility is positively affected by the determinants of supply chain – strategic partnership, information sharing, resilience, sourcing flexibility and order fulfillment flexibility.

*H1A: Strategic partnership positively affects supply agility.*
*H1B: Information sharing positively affects supply agility.*
*H1C: Resilience positively affects supply agility.*
*H1D: Sourcing flexibility positively affects supply agility.*
*H1E: Order fulfillment flexibility positively affects supply agility.*

H2: Manufacturing agility as a dimension of supply chain agility is positively affected by the determinants of responsive supply chain – strategic partnership, information sharing, resilience, sourcing flexibility and order fulfillment flexibility.

*H2A:  Strategic partnership positively affects the manufacturing agility.*
*H2B:  Information sharing positively affects the manufacturing agility.*
*H2C:  Resilience positively affects the manufacturing agility.*
*H2D:  Sourcing flexibility positively affects the manufacturing agility.*
*H2E:  Order fulfillment flexibility positively affects the manufacturing agility.*

H3: Distribution agility as a dimension of supply chain agility is positively affected by the determinants of responsive supply chain – strategic partnership, information sharing, resilience, sourcing flexibility and order fulfillment flexibility.

*H3A:  Strategic partnership positively affects the distribution agility.*
*H3B:  Information sharing positively affects the distribution agility.*
*H3C:  Resilience positively affects the distribution agility.*
*H3D:  Sourcing flexibility positively affects the distribution agility.*
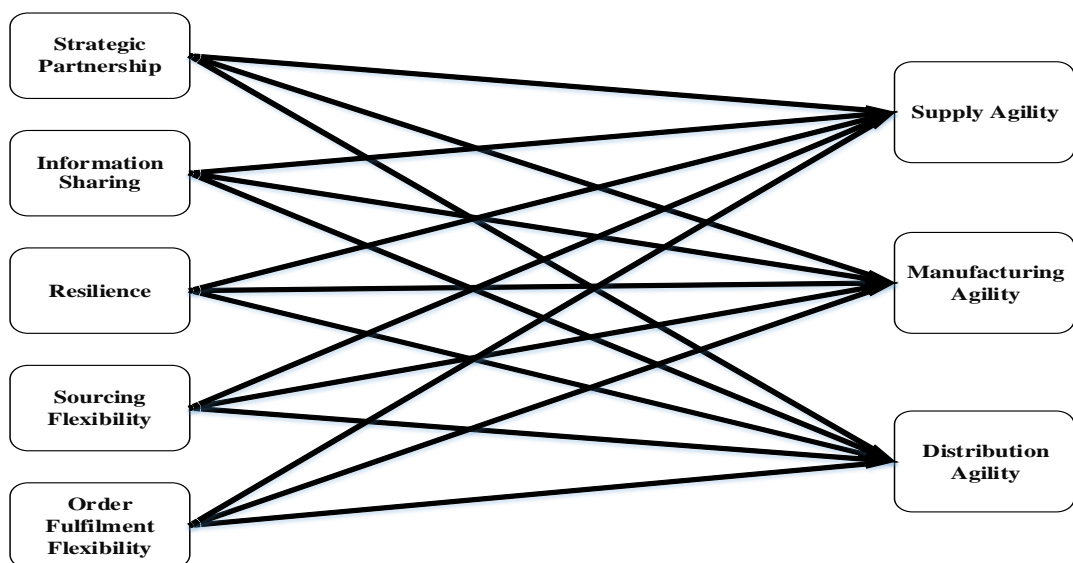*H3E:  Order fulfillment flexibility positively affects the distribution agility.*



**Figure 1: Theoretical framework**

## 3. RESEARCH METHODOLOGY

### 3.1. Sampling and data collection

The study uses a survey method for the data collection. The survey instrument includes the constructs describing different parameters. The survey questionnaire consists of eight major constructs including three constructs of agility – supply agility, manufacturing agility and distribution agility; and five constructs of determinants – strategic partnership, information sharing, resilience, sourcing flexibility, order fulfillment flexibility. Eight constructs included their defining variables that explained and formed the constructs. Supply agility includes defect replacement, suppliers' response, and suppliers' inventory. Manufacturing agility is explained by the immediate response, timely replenishment, maintained a level of retailers' stocks and meeting the production schedule. Distribution agility has been defined by the variables including logistics infrastructure, traffic, timely deliveries, and delays. Strategic partnership includes suppliers' involvement, information sharing with suppliers, relationship with suppliers and suppliers' participation in decision making. Information sharing includes real-time information about inventories and information sharing in the supply chain. Resilience is explained by risk prediction, changes in the market, safety measures and preparedness. Sourcing flexibility includes the defining variables including flexibility to add and change suppliers and coping with changes. Order fulfillment flexibility includes the expansion of distribution centers and efficiency in distribution. All the variables in the survey questionnaire were assessed using the five-point Likert scale.

The survey questionnaires were sent to the respondents personally and via electronic mail. The respondents consisted of middle and top level personnel from the garment manufacturing companies across India. A total of 56 respondents were contacted in person and their responses were recorded after the detailed personal interactions. Apart from the personal interactions, a total of 927 questionnaires were sent via electronic mail in the garment manufacturing companies across India. After continuous follow-ups and requests, a total of 172 complete responses were received. Finally, a total of 228 completed questionnaires were available in usable form for the further analysis.

Indian garment industry consists of a large number of garment manufacturers and 228 is a small sample size to be representative of such big industry. However, a smaller sample size can be representative of a huge population (Malhotra and Birks, 2007). For example, in a similar study based on supply chain responsiveness Williams *et al*. (2013) have taken a sample size of 206 respondents representing more than eighteen industries which will cover very huge population size.

### 3.2. Measurement model

The static relationship evaluates the relationship between the determinants and the agility constructs. The paper considers the agility constructs as endogenous constructs and determinants as the exogenous constructs. A relationship has been framed in a structural form as shown in figure 2. The structural model consists of the latent endogenous constructs ($\eta$), individual relationship coefficients ($\gamma$), latent exogenous constructs ($\xi$) and the error term ($\zeta$). The individual relationships between an endogenous construct and the exogenous constructs are defined by the combined behaviour of exogenous constructs and the coefficients with the inclusion of the unavoidable error term. The mathematical representation of the relationship is defined by the following equation:

$$\eta = \Gamma \xi + \zeta$$

$\Gamma$ represents the relationship coefficients or the regression weights ($\gamma_{11}$ to $\gamma_{53}$). The individual representations of each of the relationships are derived from the above equation as:

$Supply\ Agility = \gamma_{11}\ Strategic\ Partnership + \gamma_{21}\ Information\ Sharing +$
$\gamma_{31}\ Resilience + \gamma_{41}\ Sourcing\ Flexibility + \gamma_{51}\ Order\ Fulfilment\ Flexibility + \zeta_1$ ...... (1)

$$Manufacturing\ Agility = \gamma_{12}\ Strategic\ Partnership + \gamma_{22}\ Information\ Sharing +$$
$$\gamma_{32}\ Resilience + \gamma_{42}\ Sourcing\ Flexibility + \gamma_{52}\ Order\ Fulfilment\ Flexibility + \zeta_2\ ......\ (2)$$

$$Distribution\ Agility = \gamma_{13}\ Strategic\ Partnership + \gamma_{23}\ Information\ Sharing +$$
$$\gamma_{33}\ Resilience + \gamma_{43}\ Sourcing\ Flexibility + \gamma_{53}\ Order\ Fulfilment\ Flexibility + \zeta_3\ ......\ (3)$$

The individual equations represent the formation and behaviour of individual constructs of responsiveness, that is based on the set of determinants assumed to react together to produce a meaningful relationship for the situation.
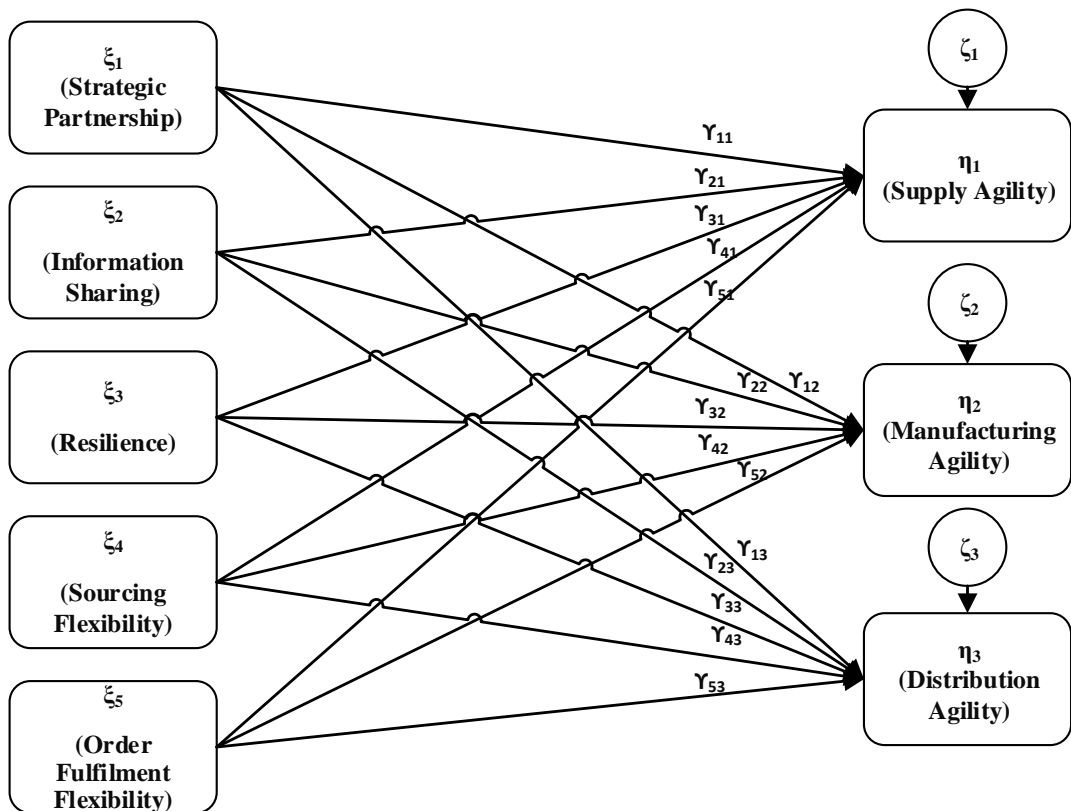


**Figure 2: Structural measurement model**

### 3.3. Common method bias test
A common method bias or common method variance test is conducted to check the response bias from the respondents because of their consistency on responding to the multiple parameters in a single survey in a cross-sectional study (Chang *et al*., 2010). Harman's single factor method (Sharma *et al*., 2009) for common method variance was used. Only 15.002% of the variance was explained by the single factor analysis. Therefore, the data seemed to be free of the common method bias.

### 3.4. Validity and reliability assessment
Measurement errors are likely to take place when the individual scores are combined in order to get a generalized result as a whole (Nunnally and Bernstein, 1994). Warmbrod (2001) has described that majority of researchers have used Cronbach's Alpha as the measure of consistency and reliability in the multiple choice Likert Scale based data analysis. The reliability test in the study observes a score of 0.766. Therefore the data are considered reliable and acceptable for the further analysis.

The analysis further analyses convergent & discriminant validity and composite reliability measurement of the latent variable structure. Table 1 shows measurements of reliability and validity. The values of Composite Reliability (CR) should be above 0.7 for an acceptable measure. Observations are above threshold limit that shows the data have high reliability. The discriminant validity measurement emphasizes on the distinguishability of indicators of one construct from the indicators of other constructs (Mackenzie *et al*., 2011). Fornell and Larcker (1981) have suggested measuring Average Variance Extracted (AVE) for discriminant validity. AVE > 0.5 indicates that majority of the variance in the first order observed variables is shared with second order latent constructs (Mackenzie *et al*., 2011). The validity check table shows AVE more than 0.5 for every latent construct which is acceptable. The square root of the values in AVE table equals the values in correlations table. CR values are also higher than the AVE values. Therefore, the composite reliability is high for every latent constructs, and there is no convergent and discriminant validity related issues in the data.

## 4. RESULTS

Results show the acceptable model fit for the hypothesized model. The value of $\chi^2$ is low at 398.587 with 385 degrees of freedom. The ratio of $\chi^2$/df is below the threshold value and $\chi^2$ is insignificant at 0.306 that indicates a good model fit. Values of all the indices including RMR, SRMR, GFI, AGFI, NFI, TLI, CFI, and RMSEA are within the threshold limits of model fitness requirements (see table 2). Having all the indices in the acceptable limits, the model indicates a close fit between the hypothesized model and the perfect fit.

Path analysis of measurement model summarizes the effects of strategic partnership, information sharing, resilience, sourcing flexibility and order fulfillment flexibility on supply agility, manufacturing agility and distribution agility. Table 3 provides a summary of path analysis with the significance of hypothesized relationships. The standard errors are low and below one which indicates minor deviations in the sampling distribution. Most of the hypothesized relationships are statistically significant. Only hypothetical relationships whose significance is statistically not proved are between: information sharing to distribution agility, resilience to distribution agility, sourcing flexibility to supply agility and order fulfillment flexibility to supply agility.

**Table 1: Validity and reliability measurement**

| | Construct reliability & validity | | Correlation | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CR | AVE | Sourcing Flexibility | Strategic Partnership | Distribution Agility | Information Sharing | Supply Agility | Resilience | Manufacturing Agility | Order Fulfilment Flexibility |
| Sourcing Flexibility | 0.936 | 0.817 | 0.915 | | | | | | | |
| Strategic Partnership | 0.928 | 0.786 | 0.071 | 0.880 | | | | | | |
| Distribution Agility | 0.927 | 0.892 | 0.139 | 0.130 | 0.932 | | | | | |
| Information Sharing | 0.876 | 0.856 | 0.035 | 0.105 | 0.007 | 0.929 | | | | |
| Supply Agility | 0.787 | 0.740 | 0.083 | 0.092 | 0.195 | 0.059 | 0.866 | | | |
| Resilience | 0.889 | 0.691 | 0.307 | 0.035 | 0.138 | 0.247 | 0.052 | 0.842 | | |
| Manufacturing Agility | 0.842 | 0.599 | -0.058 | 0.126 | -0.030 | 0.200 | 0.024 | 0.168 | 0.785 | |
| Order Fulfilment Flexibility | 0.968 | 0.931 | 0.133 | 0.105 | -0.059 | -0.049 | 0.109 | 0.145 | 0.172 | 0.964 |

**Table 2: Model fitness test**

| Indices | Statistics | Requirement | Observed |
|---|---|---|---|
| RMR | Root Mean Square Residual | Between 0 to 1 | 0.137 |
| SRMR | Standardizes Root Mean Square Residual | < 0.10 | 0.040 |
| GFI | Goodness-of-Fit Index | > 0.9 | 0.916 |
| AGFI | Adjusted Goodness-of-Fit Index | > 0.85 | 0.892 |
| NFI | Normed Fit Index | > 0.9 | 0.956 |
| TLI | Tucker-Lewis index | > 0.95 | 0.982 |
| CFI | Comparative Fit Index | > 0.97 | 0.992 |
| RMSEA | Root Mean Square Error of Approximation | < 0.05 | 0.012 |

**Table 3: Summary of path analysis**

| Relationships | | | Standardized Estimates | S.E. | C.R. | P | Significance |
|---|---|---|---|---|---|---|---|
| Distribution Agility | ← | Strategic Partnership | 0.138 | 0.069 | 2.098 | 0.036 | Significant |
| Supply Agility | ← | Strategic Partnership | 0.097 | 0.069 | 1.392 | 0.024 | Significant |
| Manufacturing Agility | ← | Strategic Partnership | 0.061 | 0.064 | 0.935 | 0.040 | Significant |
| Distribution Agility | ← | Information Sharing | -0.107 | 0.068 | -1.695 | 0.090 | Not Significant |
| Distribution Agility | ← | Resilience | 0.075 | 0.089 | 1.093 | 0.291 | Not Significant |
| Distribution Agility | ← | Sourcing Flexibility | 0.180 | 0.074 | 2.699 | 0.007 | Significant |
| Distribution Agility | ← | Order Fulfilment Flexibility | -0.121 | 0.063 | -1.927 | 0.050 | Significant |
| Supply Agility | ← | Information Sharing | 0.037 | 0.072 | 0.536 | 0.001 | Significant |
| Manufacturing Agility | ← | Information Sharing | 0.114 | 0.071 | 1.631 | 0.013 | Significant |
| Supply Agility | ← | Resilience | 0.016 | 0.093 | 0.214 | 0.037 | Significant |
| Manufacturing Agility | ← | Resilience | 0.229 | 0.094 | 2.943 | 0.003 | Significant |
| Supply Agility | ← | Sourcing Flexibility | 0.067 | 0.076 | 0.939 | 0.476 | Not Significant |
| Manufacturing Agility | ← | Sourcing Flexibility | -0.180 | 0.072 | -2.590 | 0.010 | Significant |
| Supply Agility | ← | Order Fulfilment Flexibility | 0.095 | 0.066 | 1.386 | 0.189 | Not Significant |
| Manufacturing Agility | ← | Order Fulfilment Flexibility | 0.149 | 0.063 | 2.209 | 0.027 | Significant |

Result proves significant effect of strategic partnership on distribution agility, supply agility and manufacturing agility in value of P < .05. The hypothesized relationship based on an existing relationship confirms the importance of building strategic partnerships upstream supply chain, operational level and the downstream supply chain (Cao and Zhang 2010; Simchi-Levi *et al*., 2008). Positive effect of information sharing on supply agility and manufacturing agility is also proved statistically significant which validates the literature (Bartlett *et al*., 2007). However, effect of information sharing on distribution agility is not statistically significant. The insignificant relationship between information sharing and distribution agility may be due to inadequate infrastructure that doesn't support visibility and real time information sharing in logistics activities in Indian conditions (Jayaram and Avittathur, 2012). Resilience doesn't positively influence the distribution agility. The possible reason may because resilience is more centric to manufacturers' decision making capabilities (Sheffi, 2005). On the other hand resilience positively affects the supply agility and manufacturing agility with statistical significance, which confirms the role of manufacturer in building resilience (Sheffi, 2005) as well as the importance of sourcing decisions and supplier development for resilience (Christopher and Peck, 2004). Sourcing flexibility positively affects distribution agility and manufacturing agility at significance level ≤ .01. Order fulfillment flexibility also positively affects distribution agility and manufacturing agility at significance level ≤ .05. Results confirm the existing literature emphasizing on the sourcing flexibility and supply chain flexibility in bringing overall responsiveness (Thomé *et al*., 2014; Gosling *et al*., 2010). However, supply agility is not significantly affected by both sourcing flexibility and order fulfillment flexibility which can be because of the orientation of Indian companies more towards cost and quality factors (Joshi *et al*., 2013).

## 5. DISCUSSION AND CONCLUSION

The conventional view of supply chain management emphasizes efficiency in the process while a more modern view focuses on increasing agility, adapting changes, and aligning the objectives. An agile view of the supply chain enables responsiveness at all stages of the supply chain - supply, manufacturing, and distribution. This research has followed the same route and evaluated agility at the stages. The results have provided a mixed view where some relationships are proved and others are statistically not significant. For example, strategic partnership significantly affects all the stages of agility – supply, manufacturing, and distribution agility. It confirms that strategic partnerships between manufacturers and suppliers enhance suppliers' response time to manufacturers. That increases manufacturers' responsiveness and improves distribution and logistical performance. Strategic partnerships give suppliers better understanding and ability to cope with demand variability which improves their responsiveness. To back the argument, Cao and Zhang (2010) have described that supply chain partnering activities result in collaborative advantage which directly improves performance. The level of supply chain collaboration affects the level of operational performance (Simatupang and Sridharan, 2004).

In general, the findings of this research focus on providing important implications for both practitioners and researchers. The framework for the stage-wise evaluation of agility in this research provides a theoretical foundation for researchers to establish a micro supply chain analysis approach. The study explores the key determinants vital to the performance of a supply chain. Interaction between determinants and stages of supply chain responsiveness offers insights into relationships for researchers and practitioners. There is a common consensus among many researchers that performance of the key determinants will affect the overall performance and agility of a supply chain. The study has some limitations too. The discussions and literature in the preceding sections of the paper sometimes state opinions and assumptions different from the obtained results. It can happen because of industry-specific data or due to revelations of new relationships in the stage-wise investigation.

The study provides scope for future research in the context of different industrial settings. Among other limitations the analysis is built on real-time cross-sectional data. The structural analysis part

hasn't covered the longitudinal analysis. The responses might vary over the period of time which points to the limitation of this analysis. It is possible that time-based analysis might observe some difference in the findings. The current limitation of observations from the structural model emphasizes a time-based modeling approach while considering the variations among the parameters. The study provides scope for dynamic evaluation of the existing relationships for future research. It gives future research direction towards using time-based study either by utilizing real-time longitudinal data or through simulation and mathematical modeling techniques.

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