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Supply chain agility, adaptability and alignment: empirical evidence from the Indian auto components industry

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SUPPLY CHAIN AGILITY, ADAPTABILITY AND ALIGNMENT: EMPIRICAL EVIDENCE FROM THE INDIAN AUTO COMPONENTS INDUSTRY

Abstract

Purpose – To examine when and how organizations create agility, adaptability, and alignment as distinct supply chain properties to gain sustainable competitive advantage.

Design/methodology/approach – The current study utilizes the resource-based view (RBV) under the moderating effect of top management commitment. To test our research hypotheses, we gathered 351 usable responses using a pre-tested questionnaire.

Findings – Our statistical analyses suggest that information sharing and supply chain connectivity resources influence supply chain visibility capability, which, under the moderating effect of top management commitment, enhance supply chain agility, adaptability and alignment.

Originality/value – Our contribution lies in: (i) providing a holistic study of the antecedents of agility, adaptability and alignment; (ii) investigating the moderating role of top management commitment on supply chain agility, adaptability and alignment; (iii) following the RBV and addressing calls for investigating the role of resources in supply chain management, and for empirical studies with implications for supply chain design.

Keywords Supply chain agility, supply chain adaptability, supply chain alignment, resource-based view, top management commitment, survey.

1. INTRODUCTION

Firms operating in the globalized era need to respond quickly to external changes (Lee, 2002) and challenges, including uncertainty (Prater et al. 2001; Joshi et al. 2013). Three properties differentiate firms when dealing with these issues, namely *agility*, *adaptability* and *alignment* (Lee, 2004; Lin et al., 2006). While there is rich body of literature on supply chain agility (Gligor and Holcomb, 2012; Blome et al., 2013; Gligor et al. 2015; Tarafdar and Qrunfleh, 2016), research on the combined effect of agility, adaptability and alignment is scant apart from few notable exceptions (Lee, 2004; Whitten et al., 2012; Eckstein et al., 2015). These focuses on the impact of the combination of agility, adaptability and alignment on supply chain performance (Whitten et al. 2012), or on the impact of supply chain agility and adaptability on cost performance and operational performance under the moderating effects of product complexity (Eckstein et al., 2015).

This study applies the resource-based view (RBV) (Barney, 1991) to help understand when and how organizations create agility, adaptability, and alignment as distinct supply chain properties to gain sustainable competitive advantage. In operations management and supply chain management literature, RBV has highlighted the significance of resource heterogeneity, allocation, independency, utilization, and imitability in creating capabilities for the achievement of competitive advantage (Miller and Ross, 2003; Walker et al. 2015; Hitt et al. 2016, 2016a; Ketokivi, 2016). In this study, we investigate visibility as an important capability and antecedent of agility, adaptability, and alignment. Visibility is the ability of the supply chain to enable access and sharing of information across the supply chain partners (Lamming et al., 2001). Barratt and Oke (2007) have illustrated the importance of visibility in establishing or breaking relationships between supply chain partners, obtaining a shared understanding and access to information that partners request without “loss, noise, delay and distortion”

(Hofstede, 2003, p. 18), monitoring inventory (Petersen et al., 2005), and supply chain responsiveness (Williams et al., 2013). In obtaining visibility, our study investigates two critical resources, that is, connectivity and information sharing. Fawcett et al. (2011) and Brandon-Jones et al. (2014) have described connectivity as an organization's ability to gather and share information through use of information and communication technologies (ICTs), whereas Zhu and Kraemer (2002) have noted that connectivity, which is an important tangible resource that facilitates information sharing, refers to IT infrastructure. Information sharing has to do with the "nature, speed, and quality of the information being conveyed" (Brandon-Jones et al., 2014: p. 56;). Brandon-Jones et al. (2014) have utilised the RBV to study the relationship between information sharing and supply chain connectivity (resources) to supply chain visibility (capability) and performance in terms of supply chain resilience and robustness. However, they have not investigated the role of these resources for supply chain agility, adaptability, and alignment.

Following the RBV perspective, we argue that the creation of capabilities involves complex patterns of coordination between people and other resources where organizational members are critical components (Grant, 1991). Top managers need to be committed in motivating and socializing organizational members in a manner conducive to the development of smooth-functioning routines. Hence, top management commitment (TMC) is important in explaining the relationship between acquiring resources and creating capabilities. TMC has received significant attention in the fields of ecological responsiveness (Colwell and Joshi, 2013) and enterprise resource planning (ERP) assimilation (Liang et al. 2007). In an earlier study, Lado and Wilson (1994) investigated the role of managerial competencies and capabilities in determining the acquisition, development and deployment of organisational resources and the translation of these resources into desired capabilities that can provide sustainable competitive advantage.

This study uses theory focused research (Ketchen and Hult, 2007; Choi and Wacker, 2011). Data was collected from 351 supply chain management managers in the Indian auto component manufacturing industry.

This paper offers three contributions to the SCM literature. Firstly, it theorizes and validates a model that explicates the role of supply chain visibility in creating supply chain agility, adaptability and alignment (see Barratt, 2004; Barratt and Oke, 2007; Cao and Zhang, 2011; Brandon-Jones et al. 2014). Secondly, this study investigates the moderating effect of TMC on the path connecting supply chain visibility and agility, adaptability and alignment building on Liang et al. (2007) and Colwell and Joshi (2013). Finally, following the endorsements of Joshi et al. (2013) and Kearney (2013), our study makes a significant contribution to the auto components manufacturing sector in developing countries with a particular emphasis on India, where auto components are a major contributor to GDP. Hence, it is vital for these organizations to understand how and when they could be agile, adaptable and aligned in their supply chains.

The remainder of the paper is as follows. First, we introduce our theoretical perspective, theoretical framework, and hypotheses. Next, we describe our research design followed by data analyses, and our results, followed by detailed discussion of our theoretical contributions and managerial implications. Finally, we conclude our research findings with limitations and further research opportunities.

2. THEORETICAL FRAMING AND DEVELOPMENT OF HYPOTHESES

2.1 Resource Based View

Scholars (e.g. Esper and Crook, 2014; Hitt et al., 2016) argued that the RBV can explain a variety of firm and supply chain outcomes. RBV asserts that an organization can achieve competitive advantage by building strategic resources and capabilities (Barney, 1991). Eckstein et al. (2015) have argued on the basis of prior research (see Blome et al. 2013; Gligor et al. 2013) that supply chain agility and adaptability can be considered dynamic capabilities – an extension of RBV (Teece et al. 1997) – that result from the firm's ability to reconfigure firm-level and supply-chain level resources. Augier and Teece (2009) have argued that when dynamic capabilities enable organizations to achieve coordination, they benefit from complementarities and better decision making (Augier and Teece, 2009; Gligor et al. 2012; Blome et al. 2013; Gligor and Holcomb, 2014; Gligor et al. 2015, 2016).

2.2 Supply chain agility, adaptability, and alignment

Figure 1 presents the theoretical framework of this research. Following the RBV perspective, supply chain agility, adaptability and alignment (SCAAA) are outcomes. Supply chain visibility is a capability stemming from the strategic resources of supply chain connectivity and information sharing (Barratt, 2004; Barratt and Oke, 2007; Brandon-Jones et al., 2014) and affects SCAAA.

Supply chain agility is the capability of the supply chain to respond quickly and effectively to market changes (Lee, 2002, 2004; Swafford et al. 2006). Scholars have defined supply chain agility as the ability of the firm to adjust tactics and operations within its supply chain to respond to environmental changes, opportunities, and threats (Gligor et al. 2013; Gligor and Holcomb, 2014; Eckstein et al. 2015). There is literature discussing flexibility as a construct

with dimensions including adaptability, alignment and agility (Stevenson and Spring, 2007, 2009) but this has not discussed the combined properties of adaptability, alignment, and agility.

Supply chain adaptability is the ability to adjust a supply chain's design to meet structural shifts in the markets and modify supply network [reflect changes] in strategies, technologies, and products (Lee, 2004). Ketchen and Hult (2007) define supply chain adaptability as the willingness to reshape supply chains when necessary, without ties to legacy issues or the way the chain has been operated previously. Stevenson and Spring (2007) have noted that supply chain adaptability is the property of a supply chain which allows the members to cope with the dynamics associated with supply chain. Hence, we argue that supply chain adaptability prepares the supply chain members to adjust according to the situation and gain desired competitive advantage.

Lee (2004) defines *supply chain alignment* as the ability of the supply chain to ensure equitable distribution of risks, costs, and gains among all participants. Whitten et al. (2012, c.f. Matthyssens and Vandenbempt, 2008) noted that from strategic perspective, business processes such as purchasing, manufacturing, marketing, and logistics must be aligned both externally and internally throughout the supply chain for organizations to attain competitive advantage.

In this paper, we define supply chain agility, adaptability and alignment as follows. *Supply chain agility is the property of a supply chain that enables it to sense short-term, temporary changes in supply chain and market environment, and flexibly and rapidly respond to these changes. Supply chain adaptability* is *the property of a supply chain that enables it to sense-long term, fundamental changes in the supply chain and market environment, and respond to such changes by flexibly adjusting the configuration of the supply chain. Supply chain alignment is the property of the supply chain such that the interests of all of the organizations in the supply chain are aligned through free information exchange, clearly laying out the role*

of each constituent of the supply chain and through equitable sharing of risks, costs, and benefits.

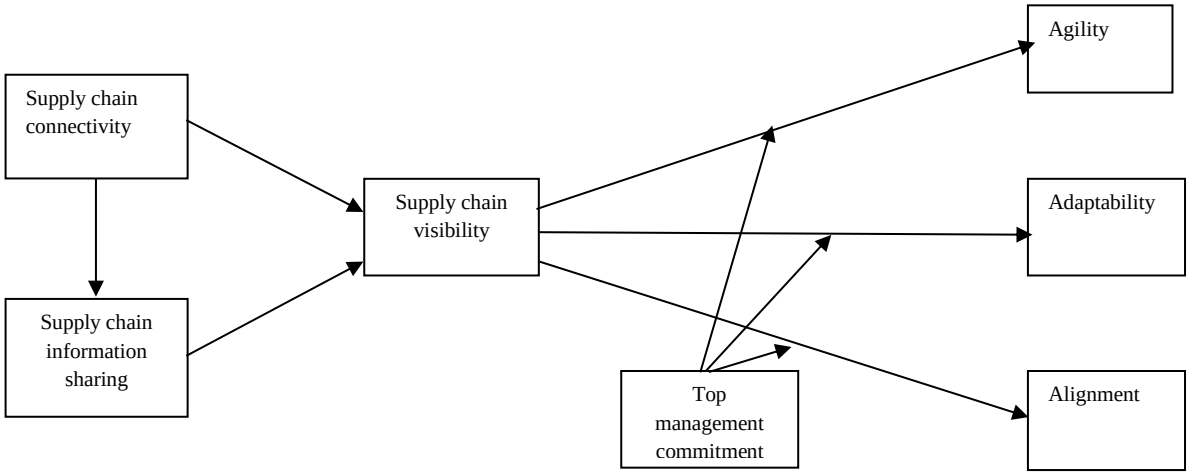

Figure 1: Research Model

2.3 Supply chain visibility

Supply chain visibility has been conceptualized as a capability (Francis, 2008; Barratt and Oke, 2007; Juttner and Maklan, 2011; Brandon-Jones et al. 2014). There is no consensus in the use of the term, with some scholars relating visibility to information sharing (Lamming et al., 2001), while others to shared understanding of product-related information, monitoring inventory (Petersen et al., 2005), supply chain responsiveness (Williams et al., 2013), and coordination during the phases of a disaster in humanitarian supply chains (Maghsoudi and Pazirandeh, 2016). Francis (2008) defines supply chain visibility as "the identity, location and status of entities transiting the supply chain, captured in timely messages about events, along with the planned and actual dates/times for these events" (p. 182). The benefits of visibility include improved responsiveness, planning and replenishment, improved decision-making, as well as quality of products (Barratt and Oke, 2007).

However, Brandon-Jones et al. (2014) have highlighted the difference between information sharing and supply chain visibility, in that the former term refers to the quality and relevance

of the information provided (Cao and Zhang, 2011), whereas the latter refers to information flow that impacts on supply chain transparency. Hence, information sharing is an intangible internal resource, whereas visibility is a capability based on both material and information flows (Brandon-Jones et al., 2014). The role of both information sharing and visibility in enabling agility has been highlighted by Christopher (2000). However, the relationship between supply chain visibility and supply chain agility, adaptability and alignment has not yet been empirically explored through survey data.

2.4 The impact of supply chain connectivity on supply chain information sharing

Following the RBV, literature has investigated supply chain connectivity (see Fawcett et al., 2009, 2011; Prajogo and Olhager, 2012; Brandon-Jones et al., 2014; Jin et al., 2014) and information sharing (Premkumar and King, 1994; Prajogo and Olhager, 2012; Brandon-Jones et al. 2014; Liu et al. 2016; Dong et al. 2016) as valuable organizational resources that are combined to generate capabilities (Grant, 1991). Barratt and Oke (2007) have argued that connectivity is a technological resource that enables effective information sharing. Fawcett et al. (2009) have also noted that supply chain connectivity has positive influence on decision-making and coordination. Brandon-Jones et al. (2014) have found that supply chain connectivity has a positive influence on information sharing. Therefore, we hypothesise

H1: Supply chain connectivity has positive influence on information sharing.

2.5 The impact of supply chain connectivity on visibility

From the RBV perspective, capabilities are performance enhancement constructs (see Newbert, 2007; Brandon-Jones et al., 2014). Barratt and Oke (2007) have conceptualized supply chain visibility (SCV) as a capability that helps an organisation to generate sustainable competitive advantage. Following Barney (1991), we argue that either information sharing as a resource or supply chain visibility as a capability or both combined together can provide competitive

advantage to an organization. Williams et al. (2013), on the other hand, investigated the role of supply chain visibility as an important driver of supply chain responsiveness under the moderating effect of internal integration. However, supply chain literature focusing on supply chain visibility has yet to understand when and how visibility is created. Following Grant (1991), we argue that bundling tangible and intangible resources (Größler and Grübner, 2006) can help to build supply chain visibility. Zhu and Kraemer (2002) have noted that connectivity refers to IT infrastructure that is regarded as important tangible resource that facilitates information sharing. Fawcett et al. (2011) and Brandon-Jones et al. (2014) have described connectivity as an organization's ability to gather and share information through use of information and communication technologies (ICTs). Connectivity can therefore allow organizations and supply chain networks to share information (Prajogo and Olhager, 2012; Brandon-Jones et al., 2014; Huo et al. 2014), which is a prerequisite for supply chain visibility. Therefore,

H2: Supply chain connectivity has a positive impact on supply chain visibility.

Since quality information sharing – measured as timely, accurate, pertinent and confidential (Brandon-Jones et al. 2014) – may lead to improved supply chain visibility (Christopher and Lee, 2004), we also hypothesise:

H3: Information sharing has a positive impact on supply chain visibility.

2.6 The impact of supply chain visibility on agility, adaptability and alignment

Williams et al. (2013) have empirically tested the impact of visibility on supply chain responsiveness under the moderating effect of internal integration. Lee (2004) has further argued that collaboration between suppliers and customers and promoting free flow of information between suppliers and customers helps to create agility in supply chain. Following

the RBV, Brusset (2016) has found a positive association between supply chain visibility and agility. Hence, we can hypothesize as:

H4: Supply chain visibility has positive impact on supply chain agility.

Barratt (2004) and Barratt and Oke (2007) have argued that supply chain visibility plays a critical role in building collaboration (Vereecke and Muylle, 2006; Vanpoucke et al. 2009). An early study by Lee (2004) has argued that continuously tracking macro factors, use of intermediaries, building flexibility and matching supply chains with product may help to create adaptability in supply chains, whereas Makris et al. (2011) further noted that visibility in supply chain helps to adapt quickly to changes. Thus, we can argue that supply chain visibility has significant influence on creating supply chain adaptability, and we hypothesize:

H5: Supply chain visibility has positive impact on supply chain adaptability.

Gattorna (1998) argued that information sharing plays a significant role in creating alignment among partners in supply chain. Later studies support this argument, suggesting that it is through supply chain visibility that information sharing enables alignment (Barratt, 2004; Barratt and Oke, 2007; Brandon-Jones et al. 2014; Brusset, 2016). Hence, we can also argue that visibility has positive impact on supply chain alignment as follows:

H6: Supply chain visibility has a positive impact on supply chain alignment.

2.7 The moderating role of top management commitment

Liang et al. (2007) argued that top management has an important role to play in any organisational initiatives, through belief and participation (Jarvenpaa and Ives, 1991). Researchers on strategy implementation have recognised the interests of the top management in the organisational strategies (Hambrick and Mason, 1984). In an early study Shrivastava (1983) argued that the top management's values and cognitive bases guide organisational strategies, decisions, and behaviour. Colwell and Joshi (2013) further argued that in order to

effect organisational change, two key factors are critical, namely commitment and capacity. Hence, the role of top management is especially critical in terms of resource allocations and deployment decisions that are necessary for organisational change. We argue that the top management angle will certainly offer interesting insights in O&SCM literature where resource allocations and deployment decisions may create differences in a dynamic environment.

Researchers have acknowledged the role of the top management team and TMC in dealing with paradoxes, contradictions, conflicts and building requisite conditions for embracing dynamic changes (Gnyawali et al. 2016). TMC ensures viability and competitiveness in increasingly turbulent environments where multiple and inconsistent demands can emerge (Smith and Tushman, 2005; Carmeli and Halevi, 2009) no matter if the existence of organisational paradoxes, contradictions and conflicts is crucial to keeping the systems viable and enabling to embrace dynamic changes to survive in the face of environmental disturbances (Carmeli and Halevi, 2009). Drawing on Morgan et al. (2007) we argue that one role of top management in supply chains is to help configure resources and capabilities to achieve competitive advantage (Augier and Teece, 2009). Prior research utilized TMC focusing on ecological responsiveness (Colwell and Joshi, 2013) and ERP assimilation (Liang et al. 2007). However, it is yet to understand how TMC can contribute to designing and shaping supply chains for uncertain and competitive environments, and subsequently, in this case, in creating supply chain agility, adaptability, and alignment.

In past scholars, have dealt with TMC as either direct variable (Babakus et al. 2003), moderator (Barrick et al. 2007; Colwell and Joshi, 2013) or mediator (Collins and Clark, 2003; Liang et al. 2007). Furthermore, Hunt and Morgan (1994) conceptualised commitment as a hybrid construct that may be a mediating as well as a direct variable. There is a lack of consensus among scholars related to the treatment of the TMC variable. It is common for social

psychological researchers to use the terms interchangeably (Barron and Kenny, 1986). Amidst this debate, we propose TMC as a moderating construct:

H7a/b/c: *Top management commitment moderates the relationship between supply chain visibility and (a) supply chain agility, (b) supply chain adaptability and (c) supply chain alignment.*

3. RESEARCH DESIGN

3.1 Construct Operationalization

This study developed a survey instrument by identifying appropriate measures from the literature review (Table 1). The constructs were measured on a five-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (5) in order to ensure high statistical variability among survey responses (see Chen et al. 2004). Prior to data collection, we pre-tested our instrument for content validity in two stages. Firstly, we asked three experienced researchers to provide feedback on the questionnaires for ambiguity, clarity, and appropriateness of the measures used to operationalize each construct (Chen et al. 2004; DeVellis, 2012). We further asked these researchers to assess the extent to which the measures sufficiently addressed the subject area (Dillman, 1978). Based on their feedback we modified the scales. Secondly, we emailed the survey to 30 senior supply chain managers affiliated with the Chartered Institute of Logistics and Transport (CILT). We asked these managers to review the survey instrument for structure, readability, ambiguity and completeness. The final survey instrument incorporated the feedback from these supply chain managers, which in turn improved the clarity in the instruments. The process yielded a survey instrument that exhibited high content validity. We operationalised all the constructs in the model as reflective (Table 1). We also included two control variables that characterize our unit of analysis, namely 'organization size', measured by total number of employees, and 'revenue generated by the

organization in a financial year' (Liang et al. 2007). We also included a control for industry dynamism in order to level out the effects of uncertainty across the industry (Wagner and Neshat, 2012; Brandon-Jones et al., 2014).

Table 1: Construct Operationalization

Construct	**Type**	**Relevant Literature**	**Measures**
Supply Chain Connectivity (SC)	Reflective	Fawcett et al. (2011); Brandon-Jones et al. (2014)	- Current information systems satisfy supply chain communications requirements (SC1). - Information applications are highly integrated within the firm and supply chain (SC2). - Adequate information systems linkages exist with suppliers and customers (SC3).
Supply Chain Information Sharing (SCI)	Reflective	Cao and Zhang (2011)	Our organization exchanges with our partners: - Relevant information (SCI1). - Timely information (SCI2). - Accurate information (SCI3). - Complete information (SCI4). - Confidential information (SCI5).
Supply Chain Visibility (SCV)	Reflective	Braunscheidel and Suresh (2009)	- Inventory levels are visible through the supply chain (SCV1). - Demand levels are visible throughout the supply chain (SCV2).
Top management commitment (TMC)	Reflective	Liang et al. (2007)	Senior management of our organisation: - believes that creating agility, adaptability and alignment in supply chain will provide significant business benefits to the firm (TMC1). - believes that by creating agility, adaptability and alignment in supply chain we may gain competitive edge over our competitors (TMC2).

			- articulates vision for creating agility, adaptability and alignment in supply chain (TMC3). - formulated a strategy for the supply chain (TMC4). - established the metrics to monitor supply chain success through creating agility, adaptability and alignment in the supply chain (TMC5).
Supply Chain Agility (SCAG)	Reflective	Whitten et al. (2012)	The organisation: - Works hard to promote the flow of information with its suppliers and customers (SCAG1). - Works hard to develop collaborative relationships with suppliers (SCAG2). - Designs for postponement. - Builds inventory buffers by maintaining a stockpile of inexpensive but key components (SCAG3). - Has a dependable logistics system or partner (SCAG4). - Draws up contingency plans and develops crisis management teams (SCAG5).

Supply Chain Adaptability (SCA)	Reflective	Whitten et al. (2012)	The organization: - Monitors economies all over the world to spot new supply bases and markets (SCA1). - Uses intermediaries to develop fresh suppliers and logistics infrastructure (SCA2). - Evaluates needs of ultimate consumers – not just immediate customers (SCA3). - Creates flexible product designs (SCA4). - Determines where the company's products stand in terms of technology cycles and product life cycles (SCA5).
Supply Chain Alignment (SCAL)	Reflective	Whitten et al. (2012)	The organization: - Exchanges information and knowledge freely with vendors and customers (SCAL1). - Lays down roles, tasks, and responsibilities clearly for suppliers and customers (SCAL2). - Equitably shares risks, costs, and gains of improvement initiatives (SCAL3).
Industry Dynamism		Brandon-Jones et al. (2014) (c.f. Wagner and Neshat, 2012)	- Rate at which products become outdated (ID1). - Rate of introduction of new products (ID2). - Rate of introduction of new operating processes (ID3). - Rate of change in customer's preferences (ID4). - Rate of research and development in the organization (ID5).

3.2 Data Collection

We used a cross-sectional electronic survey of a sample of Indian auto component manufacturing companies drawn from the ACMA directory. This unit of analysis employed in the study was at the level of manufacturing and its constituent upstream suppliers. Prior research has indicated that this unit of analysis provides a detailed understanding of how supply chain design affects performance (Roy et al. 2004). The initial sample consisting of 970 firms was compiled and validated using databases provided by Dun & Bradstreet. We focused on auto components manufacturers because of the significance of the sector. The auto component industry in India registered USD 38.5 billion in 2014-2015 with a growth of 11 percent (ACMA Annual Report 2014-2015). The Indian auto components sector exports to over 160 countries, generates a significant contribution to the Indian GDP, and provides direct and indirect employment opportunities to 19 million people (IBEF, 2016).

The title of the specific respondent sought was primarily Vice President or Director of Supply Chain Management, Logistics, or Purchasing and Materials Management. We selected these managers because they were deemed to be knowledgeable about supply chains and our related subject of interests. To improve our response rate, we followed a modified version of Dillman's (1978) total design test method. The researchers sent the survey questionnaire to each respondent via e-mail with a covering letter and followed up with phone calls. Overall, we received 351 complete and usable responses resulting in an effective response rate of 36%. Considering the length of the survey, this response rate is quite satisfactory in comparison to similar studies in recent research investigating supply chain management topics (e.g., Brandon-Jones et al. 2014; Eckstein et al. 2015). The final sample consisted of 110 Vice Presidents (31.34%), 65 Directors (18.52%), 75 General Managers (21.37%) and 101 Senior Managers (28.77%). The respondents primarily worked for medium sized firms (see Appendix 1).

We tested for non-response bias using the wave-analysis approach (see Armstrong and Overton, 1977). We compared the early and late waves of returned surveys based on the assumption that the opinions of late respondents are representative of the opinions of non-respondents (see Chen et al. 2004; Eckstein et al. 2015). The t-tests yielded no statistically significant differences between the early wave (211 responses) and late response (140 responses) groups, suggesting that non-response bias is not a problem. Following recent efforts by O&SCM scholars (see Gligor et al. 2015; Dong et al. 2016), we compared the demographics of respondents to the demographics of non-respondents via Dun & Bradstreet in order to ensure that non-response in our data is not an issue.

4. DATA ANALYSES AND RESULTS

Before evaluating the reliability and validity of the constructs and their measures, we tested for assumption of constant variance, existence of outliers, and normality. We used plots of residuals by predicted values and statistics of skewness and kurtosis. To detect multivariate outliers, we used Mahalanobis distances of predicted variables (Eckstein et al. 2015). The maximum absolute values of skewness and kurtosis of the measures in the remaining dataset were found to be 1.7 and 2.37 respectively. These values were well within the limits recommended by past research (univariates skewness<2, kurtosis<7) (Curran et al. 1996). We did not find any plots nor did the statistics indicate any significant deviances from the assumption.

4.1 Measurement Validation

To check that the measures met the requirements for reliability, validity and unidimensionality we followed the guidelines by Fawcett et al. (2014). Revelle and Zinbarg (2009) argued that Cronbach's alpha is a poor estimate of internal consistency and in some cases a gross overestimate. Henseler et al. (2009) further argued that scale composite reliability (SCR) is

considered to be more consistent in comparison to Cronbach's alpha. Hence we calculated SCR for our constructs using Fornell and Larcker's (1981) equation* as well (see Table 2).

Table 2: Loadings of the Indicator Variables

Construct	Item	Factor Loading	Variance	Error	SCR	AVE
Supply Chain Connectivity (SC)	SC1	0.83	0.68	0.32	0.85	0.66
	SC2	0.80	0.64	0.36		
	SC3	0.81	0.66	0.34		
Supply Chain Information Sharing (SCI)	SCI1	0.77	0.60	0.40	0.89	0.62
	SCI2	0.77	0.60	0.40		
	SCI3	0.85	0.72	0.28		
	SCI4	0.75	0.56	0.44		
	SCI5	0.81	0.65	0.35		
Supply Chain Visibility (SCV)	SCV1	0.81	0.66	0.34	0.76	0.62
	SCV2	0.75	0.57	0.43		
Top Management Commitment (TMC)	TMC1	0.89	0.80	0.20	0.95	0.78
	TMC2	0.89	0.79	0.21		
	TMC3	0.89	0.78	0.22		
	TMC4	0.88	0.77	0.23		
	TMC5	0.86	0.74	0.26		
Supply Chain Agility (SCAG)	SCAG1	0.85	0.73	0.27	0.96	0.82
	SCAG2	0.92	0.85	0.15		

	SCAG3	0.92	0.85	0.15		
	SCAG4	0.91	0.83	0.17		
	SCAG5	0.91	0.84	0.16		
Supply Chain Adaptability (SCA)	SCA1	0.88	0.77	0.23	0.97	0.88
	SCA2	0.86	0.74	0.26		
	SCA3	0.99	0.97	0.03		
	SCA4	0.99	0.97	0.03		
	SCA5	0.98	0.97	0.03		
Supply Chain Alignment (SCAL)	SCAL1	0.97	0.95	0.05	0.88	0.73
	SCAL2	0.97	0.93	0.07		
	SCAL3	0.55	0.31	0.69		
Industry Dynamism (ID)	ID1	0.95	0.90	0.10	0.93	0.73
	ID2	0.77	0.59	0.41		
	ID3	0.84	0.71	0.29		
	ID4	0.86	0.73	0.27		
	ID5	0.84	0.70	0.30		

***SCR= $(\sum \boldsymbol{\lambda i})$^2/(($\sum \boldsymbol{\lambda i}$)^2+$\sum(\boldsymbol{\epsilon i})$)**

We assessed two types of validity: convergent and discriminant (Fawcett et al. 2014). As shown in Table 2, items loaded on the intended constructs (with standardized loadings greater than 0.5), the SCR greater than 0.7 and the average variance extracted (AVE) greater than 0.5. Hence we can argue that there is sufficient evidence for convergent validity. Fawcett et al. (2014) noted that for discriminant validity, all the items should have higher loadings on their assigned constructs than any other constructs. Furthermore, the mean shared variance should

be below 0.50. Alternatively, the square root of the AVE for each construct should be greater than any correlation estimate (see Table 3). We can therefore argue that there is sufficient evidence for discriminant validity.

Table 3: Correlations among Major Constructs

	SC	SCI	SCV	TMC	SCAG	SCAD	SCAL	ID
SC	**0.81**							
SCI	0.63	**0.79**						
SCV	0.43	0.26	**0.79**					
TMC	0.08	0.21	0.11	**0.88**				
SCAG	-0.29	-0.21	-0.13	0.01	**0.90**			
SCAD	-0.11	-0.14	-0.09	-0.11	0.31	**0.94**		
SCAL	-0.02	-0.06	-0.05	0.05	0.12	0.29	**0.85**	
ID	0.17	0.29	-0.02	0.17	0.07	-0.03	0.15	**0.85**

We assessed unidimensionality of our theoretical model constructs via following two conditions (Gerbing and Anderson, 1988). Firstly, an item must be significantly associated with the empirical indicators of the construct and secondly, it must be associated with one and only one construct (Chen et al. 2004). To test for unidimensionality we tested the overall fit of our model. Based on the literature (see Bentler and Bonett, 1980; Bentler, 1990; Hu and Bentler, 1999; Chen et al. 2004; Ou et al. 2010; Whitten et al. 2012; Brandon-Jones et al. 2014; Eckstein et al. 2015), multiple fit criteria were utilized to assess model fit. Based on several fit indices ($\varkappa^2$/degrees of freedom=1.48; goodness of fit $[GFI] = 0.94$; adjusted goodness of fit $[AGFI] = 0.91$; Bentler and Bonett's normed fit index $[NFI] = 0.97$; Bentler and Bonett's non-normed fit index $[NNFI] = 0.96$; Bentler comparative fit index $[CFI] = 0.97$; and root mean square

error of approximation $[RMSEA] = 0.07$), we can conclude that our constructs exhibit unidimensionality.

4.2 Common Method Bias

Guide and Ketokivi (2015, c.f. Ketokivi and Schroeder, 2004) have argued that common method bias (CMB) cannot be eliminated in case of survey based research unless one uses multiple informants per observational unit. Following Podsakoff and Organ (1986), we attempted to enforce a procedural remedy by asking respondents not to estimate SCAAA on the basis of their own experience, but to obtain this information from minutes of organizational meetings or from documentation (Gligor et al. 2015). Furthermore, we performed statistical analyses to assess the severity of CMB. Researchers have developed a number of statistical techniques to control for the effect of CMB in survey-based research design (Sharma et al. 2009). We conducted Harman's single-factor test. This requires loading all the measures into an exploratory factor analysis, and analysing the unrotated factor solution with the assumption that the presence of CMB is indicated by the emergence of either a single factor or a general factor accounting for the majority of covariance among measures (Podsakoff et al. 2003, p. 889). For the first case, we fixed the number of factors equal to one, prior to obtaining an unrotated factor solution. A single factor was obtained which explains 38.69% of the variance, which should be ideally less than 50%. Secondly, we obtained eight factors varimax rotated factor solution (parsimonious structure) that explains nearly 75% of the total variance with single largest factor out of eight factors explaining less than 14% variance (i.e. 13.87%). Hence, in both the cases we observe that CMB is not a major issue. Following criticism of Harman's single-factor method (Guide and Ketokivi, 2015), we further assessed the CMB by comparing the fit between the one-factor model, the measurement model with only traits, and the measurement model with both traits and a method factor (Flynn et al., 2010; Liu et al. 2016; Dong et al. 2016). The one-factor method yielded (κ^2=1973.46, p<0.001) was significantly poor

in comparison to that of measurement model with only traits. The chi-square (κ^2=436.39, p<0.001) of the measurement model with both traits and a method factor did not significantly improve that of the measurement model with only traits. Thus, from this we can conclude that CMB may exist, but its impact on our statistical analyses is minimal.

4.3 Hypothesis Testing

We tested our research hypotheses using multiple regression analysis with moderation tests. Inspired by recent debates surrounding methodological criteria for survey based research (see Fawcett et al. 2014; Guide and Ketokivi, 2015) we conducted some additional statistical tests to strengthen our claims. Before testing the research hypotheses, we tested for the endogeneity of the exogenous variable in our model (see Dong et al. 2016; Liu et al. 2016) by conducting the Durbin-Wu-Hausman test (Davidson and MacKinnon, 1993). We first regressed SC on SCAG, SCA and SCAL, then used the residual of this regression as an additional regressor in our hypothesized equations. The parameter estimate for the residual was not significant, indicating that SCV was not endogenous in our setting, consistent with its conceptualization. Next, we tested for multicollinearity by calculating variance inflation factors (VIF) for each regression coefficient. The VIF values ranged from 1.069 to 1.234, significantly below the recommended threshold value of 10 (Hair et al. 2006). Tables 2-3 provide the results of the multiple regression analyses. Table 4 examines the research hypotheses between resources and supply chain visibility in H1-H3. Addressing H1 first, we observed (see Table 4) the supply chain connectivity (SCV) is positively associated with information sharing (SCI) (β=0.866; p<0.001). The control variables industry dynamism (ID) and organization size (OS) do not have a significant effect on SCI and SCV. Next, addressing H2 and H3, we find that both SC (β=0.736; p<0.001) and SCI (β=0.897; p<0.001) have a significant positive influence on SCV. We also note that supply chain connectivity SCI along with control variables explains 74.3% of the total variance in SCV (see R^2=0.743).

Table 4: Multiple Regression Results for Supply Chain Visibility and Information Sharing

Variables	**DV= Information Sharing**		**DV= Supply Chain Visibility**	
Controls	Beta	t-value	Beta	t-value
ID	-0.112	-2.001	-0.002	0.858
OS	-0.021	-0.346	0.00	0.004
Main effects				
SC	0.866	27.415	0.736	14.709
SCI			0.897	23.424
R^2	0.800		0.743	
Adj R^2	0.798		0.740	
Model F	405.03		291.790	

H4-H6 were tested using hierarchical regression. In support of H4, Table 5 indicates that supply chain visibility has a positive significant effect on supply chain agility (β=0.384; p<0.001). Similarly, from Table 5, we note that hypotheses H5 (β=0.147; p<0.05) and H6 (β=0.169; p<0.01) are well supported. In support of H7a and H7c, TMC has a positive significant interaction effect and H7b has significant interaction effect but the impact of SCV on adaptability is lower for higher levels of TMC.

Table 5: Hierarchical Moderated Regression Results for Agility, Adaptability and Alignment in Supply Chain

Variables	DV= Agility		DV= Adaptability		DV=Alignment	
Controls	Beta	t-value	Beta	t-value	Beta	t-value
ID	-0.125	-0.037	-0.047	-0.554	-0.045	-0.507
OS	0.001	1.47	-0.016	-0.418	-0.025	-0.628
Main effects						
SCV	0.384	8.46	0.147	3.21	0.169	3.61
TMC	0.323	6.38	0.193	4.014	0.222	4.521
Interaction effects						
SCV*TMC	0.11	3.211	-0.192	-2.77	0.09	2.256
R^2	0.304		0.051		0.063	
Adj R^2	0.290		0.037		0.049	
Model F	21.865		3.489		4.743	

5. DISCUSSION

5.1 Theoretical Implications

We investigated how supply chain agility, adaptability and alignment are created through supply chain visibility, built by resources (i.e. supply chain connectivity and information sharing).

Our first contribution lies in proposing and validating a model that explains supply chain visibility in creating supply chain agility, adaptability and alignment (see Barratt, 2004; Barratt and Oke, 2007; Cao and Zhang, 2011; Brandon-Jones et al. 2014). Apart from Whitten et al. (2012), scholars have either focused on supply chain agility or on supply chain agility and adaptability in combination but not on supply chain alignment. Furthermore, recent studies have empirically examined the impact of visibility on supply chain relationships, resource sharing, the performance of humanitarian organizations (Maghsoudi and Pazirandeh, 2016) or on supply chain resilience and robustness (Brandon-Jones et al., 2014), but not on agility, adaptability, and alignment. Whitten et al. (2012), argue that how SCAAA helps to enhance supply chain performance and organizational performance. However, we further extend the Whitten et al. (2012), study by arguing using RBV logic that what are the antecedents of SCAAA and how TMC further addresses the limitations of the RBV logic noted by previous scholars to strengthen our claim. Hence, our study suggests a significant positive relationship between supply chain visibility and agility, adaptability and alignment, thereby extending the literature on SCAAA (Lee, 2004; Whitten et al., 2012; Eckstein et al., 2015; Gligor et al., 2016).

Our second contribution lies in using RBV and the moderating effect of TMC in explaining how supply chain visibility and the creation of supply chain agility, adaptability and alignment. In O&SCM literature, scholars have used RBV (Barney, 1991; Wernerfelt, 1984) and its

extensions of the dynamic capability view (Teece et al., 1997) or the contingent resource based view (Aragon-Correa and Sharma, 2003) to investigate supply chain agility (Blome et al. 2013; Gligor et al. 2015), the combined effect of supply chain agility and adaptability (Eckstein et al. 2015), and supply chain visibility as a capability on supply chain properties such as agility (Brusset, 2016), and resilience and robustness (Brandon-Jones et al. 2014). Still, these RBV extensions have their own limitations (Ketokivi, 2016; Bromiley and Rau, 2016), in that they do not acknowledge the role of TMC in configuring resources and achieving competitive advantage (Morgan et al., 2007; Augier and Teece, 2009). Amit and Schoemaker (1993) argue that the RBV approach focuses on the characteristics of the resources and the strategic factor markets from which they are obtained to explain firm heterogeneity and sustainable competitive advantage. However, the firm decisions about selecting and accumulating resources are characterized as economically rational within the constraints of information asymmetry, cognitive biases, and causal ambiguity (Oliver, 1997). Notwithstanding its important insights, the RBV has not looked beyond the properties of resources and resource markets to explain enduring firm heterogeneity (Oliver, 1997; Bromiley and Rau, 2016), and has ignored the role of top management commitment in selecting and exploiting the strategic resources (Hunt, 1997). Our study addresses these gaps by underlining the role of TMC and arguing that TMC moderates the relationship between SCV and supply chain agility and alignment, but the impact of SCV on adaptability is lower for higher levels of TMC. Therefore, our study addresses calls, for investigating the role of resources in supply chain management (Hitt et al., 2016; Ketokivi, 2016) focusing on empirical studies that illustrate the role of resources, capabilities, and TMC in designing and building agile, adaptable, and aligned supply chains.

Our third contribution lies in providing an understanding of how organizations in developing countries and in the Indian context in particular could be agile, adaptable and aligned in their

supply chains, following the endorsements of Joshi et al. (2013) and Kearney (2013). This is important as auto components are a major contributor of the Indian GDP and the sector is facing challenges in terms of supply chain responsiveness and supply chain cost in comparison to other Asian countries (Kearney, 2013).

5.2 Managerial Implications

The current study may provide interesting insights to those managers who are contemplating to invest in supply chain connectivity and information sharing resources to improve supply chain visibility, and subsequently their supply chain agility, adaptability and alignment. In particular, our study offers several useful directions to supply chain and logistics managers who are involved in the design of supply chains. Firstly, the results of this study can be utilized to understand how inimitable resources (tangible and intangible) can be selected and utilised. Sharing relevant, complete, accurate and confidential information would contribute to better visibility in terms of inventory and demand in supply chains. Secondly, this study highlights the role of TMC in 'translating' capabilities and resources into SCAAA. No matter if an organization acquires and possesses resources, the subsequent creation of capabilities and SCAAA depends on the commitment of managers to utilize them for SCAAA. Interestingly, TMC influences not all dimensions of SCAAA in a similar fashion, so that firms have to decide if they rather prefer to enhance supply chain agility and supply chain alignment or rather facilitate higher levels of supply chain adaptability. Our results illuminate important differential effects of TMC on SCAAA, providing enhanced understanding how managers can successfully use supply chain visibility and combine it with their own commitment levels. Finally, the current study utilizes a sample from the Indian auto components manufacturing sector which faces stiff competition due to poor responsiveness and high supply chain costs. Hence, the empirical results may offer guidance to organizations and their top managers

regarding the resources needed to create visibility that impacts on SCAAA and therefore on their ability to be responsive and provide better service at a competitive price.

6. CONCLUSIONS

Drawing on RBV we developed and tested a theoretical framework that reconciles the independent contributions of two well-established streams in the literature: studies that explain the impact of RBV on supply chain properties and those that consider the role of top management in supply chain networks. We attempted to explicate how top management moderates between supply chain visibility and SCAAA. Analyses based on 351 Indian auto components manufacturers support the hypothesized relationships in the theoretical framework. The research contributes to supply chain design literature focusing on building agility, adaptability and alignment. It confirms that from an RBV perspective, the moderating effect of top management commitment can contribute to the achievement of supply chain agility, adaptability, and alignment.

6.1 Limitations and further research directions

The limitations and further research directions are outlined. Firstly, our research utilizes supply chain visibility to explain SCAAA. However, future research could investigate other resources and capabilities, such as big data & predictive analytics, to improve agility, adaptability and alignment (Gunasekaran et al. 2017; Fosso Wamba et al. 2017). Secondly, another limitation stems from our use of RBV. Since formal and informal institutions may influence the availability and acquisition of resources in a country or region (Ling-Yee, 2007; Eckstein et al. 2015), in future studies our use of RBV could be augmented by institutional theory to shed light upon the influence of these institutions (Hitt et al., 2016). Thirdly, apart from TMC, it maybe that leadership style (Messersmith and Chang, 2017) is also important in shaping the design of supply chain agility, adaptability, and alignment, and we hence may investigate its

influence. Fourthly, we acknowledge that our research is inspired by gap-spotting (Alvesson and Sandberg, 2011) and would be fruitful if 'problematization' methodology was to be followed in order to identify and challenge the underlying assumptions of current theories (in our case, RBV) and maybe lead to more influential theories. Fifthly, our study utilises cross-sectional data to test research hypotheses. However, in a recent editorial note Guide and Ketokivi (2015) argue that CMB may be an issue. To address this issue, we followed the guidelines by Podsakoff et al. (2003), but in the case of self-reported data the CMB will always be present (Ketokivi and Schroeder, 2004). Hence, for future studies we recommend to gather data from multiple respondents from same observational unit. Finally, it may be useful to conduct our study in other sectors to understand the role of visibility and its constituent resources in creating agility, adaptability and alignment in supply chains.

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Appendix 1: Sample characteristics (n=351)

Number of employees	n	%
Less than 100	48	13.68
101-500	70	19.94
501-1000	100	28.49
1000 or more	133	37.89

Annual Sales (US$)	n	%
150 million and above	120	34.19
more than 100 million and less than 150 million	150	42.74
Less than 100 million	81	23.08

Position of the respondents	n	%
Directors	65	18.52
Vice-Presidents	110	31.34
General Managers	75	21.37
Senior Managers	101	28.77