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ANTECEDENTS OF LOW CARBON EMISSIONS SUPPLY CHAINS

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ABSTRACT

Purpose – The low carbon economy is the pressing need of the time. Despite efforts taken by governments and large corporations, there is still research to be conducted exploring the role of top management commitment in translating external pressures into responses that help to build low carbon emissions in supply chains.

Design/methodology/approach – We have grounded our framework in institutional theory, agency theory and contingency theory. On the basis of existing literature, we have drawn four hypotheses. To test our hypotheses, we developed and pre-tested our questionnaire. Finally, we performed statistical analyses to test our research hypotheses using 176 samples gathered using the pre-tested questionnaire following Dillman's (2007) total design test method.

Findings – Our results suggest that coercive pressures and mimetic pressures under mediating effect of top management commitment have significant influence on organizational response to low carbon emissions. We further note that supply base complexity has moderating effects on the link between top management commitment and organizational response towards low carbon emissions.

Originality/value – Our study offers valuable insights to those managers and environmental consultants who view supply base complexity as limitations. However, our results indicate that supply base complexity may help to enhance the effectiveness of top management commitment on organizational response towards low carbon emissions.

Keywords: Carbon Emissions, Environmental Sustainability, Institutional Theory, Contingent Theory, Supply Base Complexity, Top Management Commitment, Moderating Regression, Mediation Test, Empirical Studies.

Paper type- Research paper

1. INTRODUCTION

The rapid change in climate has affected business strategies significantly (Hoffman, 2005; Shaw et al. 2013; Fang et al. 2013; Montoya-Torres et al. 2015). The growing understanding of the need to develop resilience and sustainability (Fahimnia and Jabbarzadeh, 2016), has put pressure on traditional supply chains to meet the needs of a low-carbon economy (Norton et al. 2015).

Supply chain design can help firms realize benefits in terms of reduced inventories and cost, high responsiveness, and improved strategic focus in terms of design, execution and capital investments (Melnyk et al. 2014). In recent years, in the drive of achieving operational efficiencies and keeping supply chains lean, organizations have exposed themselves to multiple risks associated with supply chain networks (Chopra and Sodhi, 2014), such as over reliance over single suppliers or single logistics service providers. Bode et al. (2011) noted that in recent years supply chains have been exposed to greater vulnerabilities due to tighter coupling, increased complexities, reduced inventory levels, and ever-greater increasing geographic dispersion. Guha-Sapir et al. (2012) further argued that the rapid increase in the frequency and impact of disruptions may be ascribed to a rise in events such as natural disasters that are beyond managerial control. For example, during 2011 when the Tsunami struck Japan, corporations were not prepared for one of the century's deadliest challenges. The impact of the Japan Tsunami on world economy was much larger than what it would have caused to the world economy if it had happened during 1970's - 1980's. Organizations based in the USA and European countries were most affected as the majority of automobile components and electronics goods are produced and supplied globally from Japan (Chopra and Sodhi, 2014). After 2011, extensive flooding in Thailand had severely impacted the manufacturing supply chains. Dell and HP were badly impacted as nearly one-third of the hard disks are produced in Thailand. Following the globally increasing frequency and impact of natural disasters events, the CEOs of large corporations have expressed their serious concerns about the slowing down of economies, natural disasters in the Far East, and emerging environmental regulations in different parts of the world (Jackson, 2014). Pacala and Socolow (2004) argue amongst others the prevailing view that human economic activities have been the single major cause for rapid change in climate. To achieve revolutionary change, the industry activities that produce carbon emissions need to be reduced significantly without impacting on economic growth. CDP (2015) have noted that on average 50% of the total carbon emissions comes from each corporation's supply chain. Norton et al. (2015) further noted the pressing need for low carbon supply chains.

While there is rich body of literature focusing on low carbon supply chains (Hua et al. 2011; Hitchcock, 2012; Benjaafar et al. 2013; Shaw et al. 2013), research on drivers of low carbon supply chains is scant (Zhao et al. 2012). Existing studies focus mainly on green supply chain management implementation using organizational theories (Sarkis et al. 2011). There are few studies utilizing institutional theory to understand the role of external pressures on supply chain members to commit to reducing carbon emissions in the supply chain (Kauppi, 2013). However, following Zhu and Sarkis (2007a, b) arguments that institutional pressures have significant influence on green supply chain management (GSCM) practices, researchers investigating developing countries such as India (Dubey et al. 2015) and Brazil (Seles et al. 2016) have further supported the institutional view. However, no matter if institutional theory has emerged as a powerful theory to provide an explanation of organizational action in response to institutional pressures, it has often been criticized as largely being used to explain both the persistence and the homogeneity of institutions (see Dacin et al. 2002). Dacin et al. (2002) have noted that notion of institutional change may offer a better explanation. Following criticism of institutional theory, researchers (see Greenwood and Hinings, 1996; Delmas and Toffel, 2008) have argued to include intra-organizational dynamics within the institutional framework. Following Colwell and Joshi's (2013) arguments we have incorporated top-management commitment as an important construct within the institutional framework. Hence, we address the first research question:

RQ1: What are the effects of institutional pressures and top management commitment on the low carbon emission?

We follow Boyd et al. (2012) and Eckstein et al.'s (2015) arguments that direct effect on performance is often crucial, but it is not sufficient enough to explain business complexities. Furthermore, following the arguments of Sousa and Voss (2008), we ground our discussion on the view that the impacts of institutional pressures may be contingent upon specific conditions (Eckstein et al. 2015, cf. Sousa and Voss, 2008). This view stems from contingency theory (CT) (Donaldson, 2001). For this we adopt CT as theoretical lens to examine the contextual conditions under which the institutional pressures under mediating role of top management are effective.

Supply base complexity has been recognized as a key managerial concern (Brandon-Jones et al. 2014) and a critical moderating factor. In this regard we may assume that supply base complexity may enhance or hamper the effectiveness of the institutional pressures under the mediating effect of top management commitment. However, such significant effects have not been addressed in the existing literature. In this study, we focus on supply base complexity as a key facet of low carbon supply chain. In the past scholars have noted that supply base complexity relates to the number of suppliers (scale complexity), delivery reliability of suppliers (delivery complexity), differentiation between suppliers, and geographic dispersion (see Vachon and Klassen, 2002; Choi and Krause, 2006; Caridi et al. 2010; Brandon-Jones et al. 2014). The complexity increases as organizations utilize higher number of suppliers, since there are additional responsibilities of managing relationships, alongside additional information and product flows to oversee (Bozarth et al. 2009; Brandon-Jones et al. 2014). On the other hand, delivery with longer lead times further increases the complexity (Chen et al. 2000). Choi and Krause (2006) argue that differences in terms of cultural, practical and technical differences increase complexity. Finally, geographic dispersion may enhance complexity in terms of cultural and linguistic differences (Stringfellow et al. 2008), unpredictable quality (Gray et al. 2011), and variable lead times (Holweg et al. 2011). Hence, we argue that each dimension of complexity may generate uncertainty, and if the institutional pressures are not properly translated into desired actions, low carbon benefits in the supply chain may not be effectively realized. We therefore investigate supply base complexity as our next research question:

RQ2: What are the effects of supply base complexity on the relationships between top management commitment and low carbon emission?

We answer these research questions based on sample of 176 Indian manufacturing firms, using appropriate multivariate statistical tools. In doing so we offer two major contributions to the existing literature. First, building on Zhu and Sarkis (2007a, b) we argue that a mediating role of human agents may help to translate pressures into desired actions. Second, we build upon prior research (see Zhu and Sarkis, 2007a, b; Seles et al. 2016) by adding contingent effects of supply base complexity on the effect of top management commitment on low carbon emissions. With this we can address how supply base complexity may explain the different levels of institutional pressures' influence on low carbon emissions.

The remainder of the paper is structured as follows. First, we have described underpinning theories. Second, we present our theoretical framework and draw testable hypotheses. Third, we describe our research design. Fourth, we present our data analyses and results. Finally, we discuss the theoretical contributions, managerial implications, limitations and future research directions.

2. UNDERPINNING THEORIES

We have grounded our hypothesized framework (Figure 1) in three theories: institutional theory (DiMaggio and Powell, 1983), top management commitment (Liang et al. 2007) and contingency theory (Donaldson, 2001). In the last decade, institutional theory has emerged as a powerful theory to account for the influence of external institutions on organizational decision making and outcomes (Kauppi, 2013). We argue that institutional pressures retain their influence on the action of managers to reduce the negative influence of the carbon emissions in supply chain. However, the direct effect of institutional pressures may not have a significant impact on the behaviour of the managers within the organizations. Thus we argue that top management commitment may help to translate the influence of institutional pressures into desired actions to reduce the carbon emissions in supply chain resulting from various supply chain activities. We follow Sousa and Voss' (2008) arguments that the impact of the institutional pressures under mediating effect of top management commitment may be contingent upon specific conditions, as the direct effect on environmental performance may not be significant.

2.1 Institutional Isomorphism and Low carbon emissions

Institutional theory explains the influence of external social, technical and political environments on organizational behaviour such as commitment towards low carbon emissions (Zhu and Sarkis, 2007a, b; Dubey et al. 2015). Other organizational theories such as the resource based view (RBV) (Barney, 1991; Grant, 1991) suffer from context insensitivity (Ling-Yee, 2007). Oliver (1997) has noted that despite RBV's popularity, the theory has never looked beyond the properties of the resources and resource markets to explain enduring firm heterogeneity. Transaction cost economics (Williamson, 1981) argues that behaviour of the supply chain members is purely guided by limited rationality and opportunistic behaviour. However, on the other hand institutional theory posits that structural and behavioural changes in the organizations are driven less by competition and efficiency, but more by the need for legitimacy. The drive for legitimacy in the organization giving rise to institutional isomorphism (DiMaggio and Powell, 1983).

DiMaggio and Powell (1983) argue that there are three types of institutional pressures: coercive, normative, and mimetic pressures. *Coercive isomorphism* results when organizations accept formal and external pressures imposed on them. They may arise from government regulations and policies and from industry and professional networks and associations, or in the form of competitive necessity within an industry or market segment (Liang et al. 2007).

Normative isomorphism occurs as a result of professionalization defined as "*the collective struggle of members of an occupation to define the conditions and methods of their work, to control the production of the future member professionals, and to establish a cognitive base and legitimization for their occupational autonomy*" (DiMaggio and Powell 1983)

Mimetic isomorphism arises as a result of organizations responding to uncertainty by mimicking the actions of other successful organizations. DiMaggio and Powell (1983) argue that when organizations have limited understanding of the technologies, or when their organizational goals are ambiguous, or when the environment creates uncertainty, they may model themselves upon other organizations perceived to be legitimate or successful. Staw and Epstein (2000) argue that mimicry action is often associated with the bandwagon effect, whereas Liang et al. (2007) note that mimetic isomorphism has significant influence in organizational decision making processes.

2.2 Top management commitment and low carbon emissions

Zhu and Sarkis (2007a) argue that institutional theory may predict institutional isomorphism, however organizations have reflected diversity with respect to the degree of success in terms of reduction of carbon emissions in supply chain. To study this diversity, we posit that top management is the primary human agent that translates the external pressures into desired managerial actions such as changing organizational structures and establishing policies based on the beliefs of institutional perspectives. Weaver et al. (1999) argue that external pressures for social performance encourage easily decoupled processes but top management commitment can encourage both easily decoupled and integrated processes. Ageron et al. (2012) argue that top management commitment plays a significant role in sustainable supply chain management. Weaver et al. (1999) in the context of social performance and others in the context of environmental performance (see, Colwell and Joshi, 2013) argue about the mediating role of top management commitment; however currently empirical testing is scant, giving us the impetus for this paper.

2.3 Supply base complexity, top management commitment and Low carbon emissions

Gupta et al. (1994) argue that integration of contingency theory with institutional theory can offer better explanation to control and coordination. Contingency theory (CT) is a mid-range theory that involves identifying and matching context settings with form settings (Hambrick, 1983; Eckstein et al. 2015). CT argues that firms should adapt structures and processes to achieve fit with the environment to attain superior performance (Donaldson, 2001). We further build upon Gupta et al.'s (1994) arguments that institutional pressures under mediating effect of top management commitment may impact carbon emissions in supply chains under particular contingencies. Our study responds to the challenge to examine the contingent effect of supply base complexity on the relationship between top management commitment and low carbon emissions. Colwell and Joshi (2013) argue that institutional pressures under efficient and effective guidance of committed managers may help reduce carbon emissions, however the contingent conditions under which the influence of top management commitment may have an enhanced effect on low carbon emissions are still underdeveloped. Therefore, we address this gap.

3. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Based on our theoretical proposition that top management commitment mediates the effect of institutional pressures on low carbon emission, under the moderating influence of supply base complexity, we developed our hypothesized framework (Figure 1). We do not exclude the possibility that other factors may have confounding effect on dependent variables. Hence, we have controlled the effect of those confounding variables (see Figure 1). Here we conceptualize carbon emissions as a third-order reflective construct, the top management commitment as a second-order reflective construct, and institutional pressures as a multi-dimensional first order reflective construct. We propose four research hypotheses grounded in the environmental sustainability literature focusing on carbon emissions.

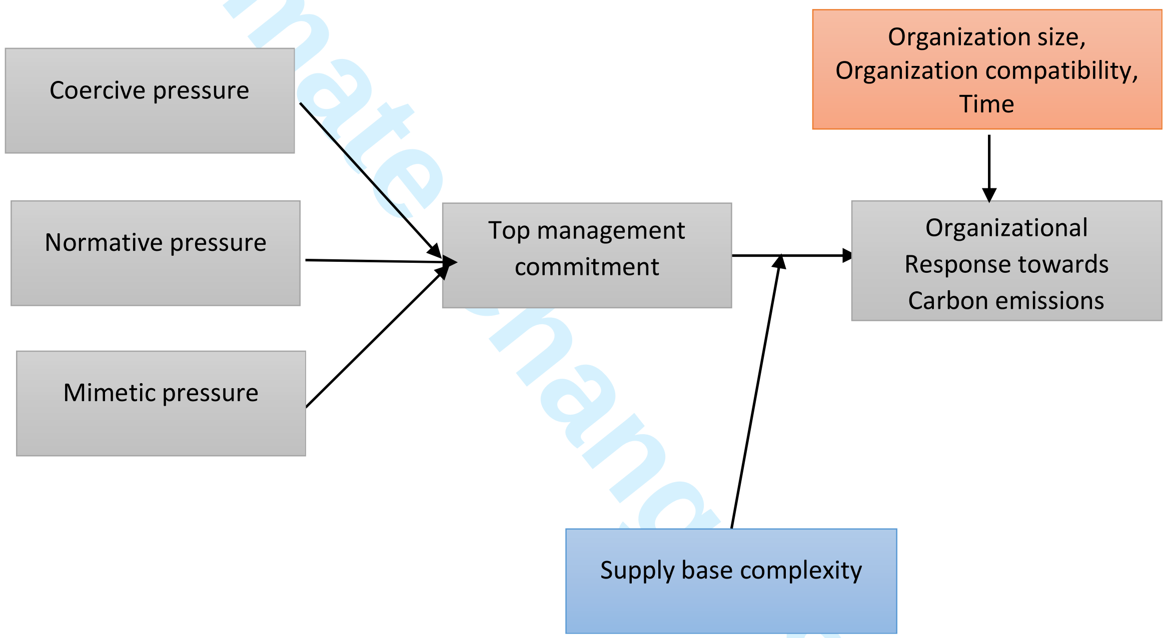

Figure 1: Hypothesized framework

3.1 The Role of Institutional Pressures on Carbon Emissions under mediating effect of Top Management Commitment

Following Colwell and Joshi's (2013) arguments we argue that top management commitment mediates between institutional pressures and carbon emissions. DiMaggio and Powell (1983) argue that coercive pressures, normative pressures and mimetic pressures trigger organizational environmental responsiveness by creating a sense of legitimacy around these actions (Colwell and Joshi, 2013). We have grounded our discussion on the basis of Greenwood and Hinings (1996, 1988) on the role of intra-organizational dynamics in fostering organizational change in response to external pressures. The two components that are vital for successful organizational change are a commitment to reform and a capacity for change. Colwell and Joshi (2013) argue that both commitment and capacity can be found throughout the organization, but the role of top management is especially critical because it can make the resource allocation and deployment decisions that are necessary to effect change (González-Benito and González-Benito, 2010; Renukappa et al. 2013). Hence, we argue that when top management commitment is high, institutional pressure for the adoption of practices which may help to reduce the carbon emissions is (i) more likely to be attended to as it is in line with the organization's vision and (ii) more likely to be implemented because the organization has the capabilities that are needed to make the transition from its existing (high carbon emission) production system to the new production system (low carbon emissions) (Colwell and Joshi, 2013). Hence we propose:

H1: Coercive pressures under mediation effect of top management commitment have a significant positive effect on low carbon emissions in supply chain;

H2: Normative pressures under mediation effect of top management commitment have a significant positive effect on low carbon emissions in supply chain;

H3: Mimetic pressures under mediation effect of top management commitment have a significant positive effect on low carbon emissions in supply chain.

3.2 The Moderating Role of Supply Base Complexity

Prior research has recognized the role of supply base complexity on organizational performance (Choi and Krause, 2006). In recent years, increasing globalization, offshoring of manufacturing, and increase in supplier base has attracted increasing attentions of management scholars to address the role of supply base complexity on supply chains. However, despite the increasing contributions, the role of supply base complexity on effect of top management commitment on environmental sustainability or supply chain sustainability is underdeveloped. The supply base complexity stems from number of suppliers (scale complexity), delivery reliability of suppliers (delivery complexity), differentiation between suppliers, and geographic dispersion (Caridi et al. 2010; Brandon-Jones et al. 2014). The complexity of the organizations increases when organizations commit themselves to utilize more diversified suppliers (Bozarth et al. 2009). Organizations need to deploy more resources to manage the flow of information, materials, and funds. Kotabe and Murray (2004) argue that the increased instability of the exchange rate in recent years has led to increased difficulties in managing globally scattered suppliers. However, some organizations may successfully explore as well as exploit the opportunities. Edmondson et al. (2003) have noted significant inconsistencies in terms of results related to effect of top management commitment on organizational performance. The top management team is often exposed to varied situations. For instance, the asymmetric distribution of information, interest and demographics of top management team posit an interesting challenge. We therefore argue that the role of top management commitment on the carbon emissions is contingent to specific conditions. Hence, we propose the moderating effect of supply base complexity on the role of top management commitment on carbon emissions as,

H4: The supply base complexity moderates the relationship between top management commitment and low carbon emissions in supply chain;

4. RESEARCH DESIGN

4.1 Measures

In our study we have used a survey based approach to gather data to test our four research hypotheses. A survey instrument was developed by identifying appropriate measurements from a comprehensive literature review. All of the constructs in the model were operationalized as the reflective constructs as discussed in Table 1.

Table 1: Constructs Operationalization

Main constructs	**Type (Reflective or Formative)**	**Measures**	**Reference**
Coercive Pressures (CP)	Reflective	1. Firms in our industry that did not meet the legislated standards for carbon emissions control faced a significant threat of legal prosecution. 2. Firms in our industry were aware of the fines and penalties potentially associated with environmentally irresponsible behaviour. 3. If the firms in our industry committed an environmental infraction, the consequences would likely have negative reports by industry/stock market analysts. 4. There were negative consequences for companies that failed to comply with the federal and provincial environmental laws.	Liang et al. (2007); Colwell and Joshi (2013)
Normative Pressures (NP)	Reflective	1. Our industry had trade associations (or professional associations) that encouraged organizations within the industry to become more environmentally responsible. 2. Our industry expected all firms in the industry to be environmentally responsible. 3. Being environmentally responsible was a requirement for firms to be part of this industry.	Liang et al. (2007); Colwell and Joshi (2013)
Mimetic Pressures (MP)	Reflective	1. The leading companies in our industry set an example for environmentally responsible conduct. 2. The leading companies in our industry were known for their practices that promoted environmental preservation. 3. The leading companies in our industry worked on ways to reduce their impact on the environment.	Liang et al. (2007); Colwell and Joshi (2013)
Top management commitment (TMC)	Reflective	1. Our firm's environmental efforts received full support from our top management. 2. Top management was committed to reducing carbon emissions resulting from various supply chain activities. 3. Our top management team consistently assessed the impact of our business on the environment. 4. Our top management team demonstrated behaviour that indicated that they valued natural environment as much as profits.	Colwell and Joshi (2013)

Supply base complexity (SCBC)	Reflective	1. Our supply chain is very complex. 2. Our supply chain involves lot of players. 3. Suppliers in this supply chain are of the same size. 4. Suppliers in this supply chain have the same level of technical capability. 5. We can depend on on-time delivery from suppliers in this supply chain. 6. We can depend on short-lead times from suppliers in this supply chain.	Brandon-Jones et al. (2014)
Organization response towards low carbon emissions (ORLC)	Reflective	1. Our firm constantly reviewed its production systems to look for ways of reducing our impact on the environment. 2. Our firm reduced its use of non-renewable resources. 3. Our firm invested in projects to restore environmental damages caused by previous industry practices (i.e. clean-up, planting trees etc.). 4. Our firm invested in low-carbon technology. 5. Our firm periodically conducts environmental audits on its operations or practices.	Colwell and Joshi (2013)
Controls			
Organization size		1. Number of employees. 2. Revenues.	Liang et al. (2007)
Organization compatibility	Reflective	1. Created a disruption in the workplace at the time. 2. Decreased productivity at the first time due to learn. 3. Required an overall change in the values, norms and culture within the organization.	Liang et al. (2007)

4.2 Survey Instrument

The theoretical constructs were developed based on extensive literature review. The reflective constructs were measured using a five-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (5) in order to ensure high statistical variability among the responses.

Prior to data collection, we pre-tested our instrument following Chen and Paulraj's (2004) suggestions for content validity in two stages. First, we invited six researchers who have published their research works on climate change in the reputable Journals (ABS 3* and above) to critique the questionnaire for ambiguity, clarity, and appropriateness of the items used to operationalize each construct (see Table 1). These researchers were asked to assess the extent to which the indicators sufficiently addressed the subject area (Dillman, 1978). Based on the inputs of these researchers we made modifications to enhance the clarity and appropriateness of the measures to address the constructs.

In the second stage we e-mailed the questionnaire to 23 materials managers, procurement managers and supply chain managers affiliated with the Indian Institute of Materials Management Pune and Mumbai chapters. These senior executives were asked to review the questionnaire for structure, readability, ambiguity, and completeness. The final survey instrument incorporated the inputs from these senior managers, which we believe has enhanced the clarity of the wording in the instrument. The two stage process yielded a survey instrument which exhibits high content validity.

4.3 Sampling Frame and Data Collection

The unit of analysis employed in this study was at the level of manufacturing plant and its constituent suppliers. Prior research has indicated that manufacturing firms provide a detailed understanding of how various activities in supply chain affect carbon emissions (Jaffe et al. 1995; Klassen and Vachon, 2003; Yang et al. 2011; Zhu and Geng, 2013). The target sample was composed of senior managers included in the Indian Institute of Materials Management (IIMM) database. We selected 372 potential respondents by their job function (materials manager or equivalent) from five energy-intensive sectors suggested by Smale et al. (2006), that is, cement, newsprint, steel, aluminium and petroleum.

In an effort to increase the response rate, a modified version of Dillman's (2007) total design test method was followed. Survey questionnaires were sent to the target respondents along with a covering letter via e-mail. One week after the first e-mail, we sent the first reminder via e-mail. After second week we received 146 responses. Out of first 146 responses we discarded 7 responses due to incomplete information. After one month we sent a second reminder. Within seven days after we had sent the second reminder we had received 42 responses and discarded 5 responses due to incomplete information. After 9 weeks we had received in total 176 usable responses (47.31%). We consider our response rate quite satisfactory in comparison to the recent studies in OSCM field (see Eckstein et al. 2015).

To test for non-response bias, we compared the responses of early and late waves of returned surveys following Armstrong and Overton's (1977) suggestions. Student's t-tests yielded no statistically significant differences (p=0.45) between early-waves (139) and late-waves (37) groups, suggesting that non-response bias was not a problem.

The final sample is described in Table 2. It consisted of 21 directors (11.93%), 45 vice-presidents (25.57%) and 110 general managers (62.50%). The respondents were drawn from five different sectors. 34.09% of the respondents were from cement sector, 11.36% of the respondents were from newsprint, 28.41% of the respondents were from steel manufacturing sector, 11.93% from the aluminium sector and 14.20% were from the petroleum sector. 56 respondents (31.82%) were from those organizations which have more than 1000 employees and 80 respondents (45.45%) were from those organizations which have more than 500 employees but less than 1000 employees.

35 (19.89%) of the respondents were from those organizations which had gross income more than 150 million USD, 76 (43.18%) were from those organizations which had gross income more than 100 million USD but less than 150 million USD and 65 (36.93%) of the respondents were from organizations which had gross income less than 100 million USD.

Table 2: Descriptive Statistics of Sampling Frame

Sector	Count	Percent
Cement	60	34.09
Newsprint	20	11.36
Steel	50	28.41
Aluminium	21	11.93
Petroleum	25	14.20
Number of employees		
Less than 100	10	5.68
101-500	30	17.05
501-1000	80	45.45
1000 or more	56	31.82
Annual Sales ($)		
150 million and above	35	19.89
more than 100 million and less than 150 million	76	43.18
Less than 100 million	65	36.93
Position of the respondents		
Directors	21	11.93
Vice-Presidents	45	25.57
General Managers	110	62.50

5. DATA ANALYSES AND RESULTS

Before we proceed further, it is very important that we should check the indicators for the assumption of constant variance, existence of outliers, and normality (Dubey et al. 2015; Eckstein et al. 2015). We used plots of residuals by predicted values, rankits plot of residuals, and statistics of skewness and kurtosis. The maximum absolute values of skewness and kurtosis of the indicators in the remaining data sets were found to be 1.83 and 4.14 respectively. These values are well within the limits recommended by past research (univariate statistics <2, kurtosis <7) (Curran et al. 1996; Dubey et al. 2015; Eckstein et al. 2015). Hence, we finally conclude that neither the plots, nor the statistics indicated any significant deviances from the assumption.

5.1 Measurement Model

We conducted confirmatory factor analysis (CFA) using AMOS 19.0 (see the results displayed in Table 3), in order to estimate the measurement properties of the multi-item reflective constructs used in our hypothesized framework (see Figure 1). All the factor loadings were greater than 0.5 standard (Hair et al. 2006), except for CP1 and TMC1 whose factor loadings were lower than 0.4. Hence, we dropped the CP1 and TMC1 from further analyses and performed rotation on remaining indicators. We obtained a parsimonious stable structure (see Appendix). The measurement model revealed a good fit of the model to the data. We observed the (χ^2/df) = 1.67; CFI (comparative fit index) =0.98 and RMSEA (root mean square error of approximation) =0.06, each supporting a good model fit.

In support of convergent validity, we observed that all the factor loadings (λi) of remaining indicators were greater than 0.5, the scale composite reliability (SCR) of each construct used in the hypothesized framework (see Figure 1) is > 0.7 and the average variance extracted (AVE) value was in excess of 0.5 (Fornell and Larcker, 1981; Hair et al. 2006).

Table 3: Confirmatory Factor Analysis (CFA)

Indicators	λ	λ^2	E	SCR	AVE
CP2	0.84	0.71	0.29	0.80	0.57
CP3	0.80	0.64	0.36		
CP4	0.60	0.36	0.64		
NP1	0.71	0.50	0.50	0.85	0.65
NP2	0.87	0.76	0.24		
NP3	0.83	0.69	0.31		
MP1	0.75	0.56	0.44	0.83	0.62
MP2	0.78	0.61	0.39		
MP3	0.83	0.69	0.31		
TMC2	0.88	0.78	0.22	0.84	0.64
TMC3	0.81	0.66	0.34		
TMC4	0.69	0.48	0.52		
SCBC1	0.76	0.57	0.43	0.88	0.56
SCBC2	0.74	0.54	0.46		
SCBC3	0.77	0.59	0.41		
SCBC4	0.61	0.38	0.62		
SCBC5	0.84	0.71	0.29		
SCBC6	0.75	0.56	0.44		
ORLC1	0.67	0.44	0.56	0.88	0.61
ORLC2	0.54	0.30	0.70		
ORLC3	0.90	0.80	0.20		
ORLC4	0.92	0.84	0.16		
ORLC5	0.81	0.66	0.34		
OC1	0.70	0.48	0.52	0.84	0.65

OC2	0.86	0.73	0.27		
OC3	0.85	0.72	0.28		

For discriminant validity, we compared the construct intercorrelations with AVEs. Table 4 displays the bivariate intercorrelations for the constructs of interest to the study.

	CP	NP	MP	TMC	SBC	ORLC	OC
CP	***0.75***						
NP	0.52	***0.81***					
MP	0.35	0.38	***0.79***				
TMC	0.33	0.26	0.26	***0.80***			
SBC	0.36	0.19	0.17	0.14	***0.75***		
ORLC	0.04	0.03	0.02	0.10	-0.02	***0.78***	
OC	0.17	0.10	0.05	-0.07	0.23	0.10	***0.81***

Table 4: Intercorrelations of Constructs

From Table 4 we observe that square root of the AVEs in the leading diagonal of the matrix is greater than the correlation coefficient value in the corresponding row and column, supporting discriminant validity.

5.2 Common Method Bias

Our study utilized survey-based data to test our research hypotheses. However, as with all self-reported data, there is high risk for common method biases resulting from multiple sources such as consistent motif and social desirability (Podsakoff and Organ, 1986; Podsakoff et al. 2003). Following Podsakoff and Organ (1986), we attempted to enforce a procedural remedy by requesting respondents not to respond to the questions purely on the basis of their personal experience but to consult their company documents and minutes of the meetings. In addition, we performed statistical analyses to assess the severity of common method bias. For this we conducted Harmon one-factor test (Podsakoff and Organ, 1986) on seven constructs in our hypothesized framework (see Figure 1). The results from this test show that all seven factors are present and the most covariance explained by one factor is 12.88% (see Appendix), indicating that common method biases are not likely to contaminate our statistical analyses.

5.3 Hypothesis Testing

We tested our hypotheses H1-H3 using regression analysis according to the procedure of Baron and Kenny (1986) (see Table 5).

Table 5: Regression Results for Mediation Test for TMC

Hypothesis	Model	Path A	Path B	Path C	Path D	Mediation	Sobel p value	S/NS
H1	CP-TMC-ORLC	β=0.16; p=0.00	β=0.43; p=0.00	β=0.2; p=0.00	β=0.11; p=0.04	Partial	0.007	S
H2	NP-TMC-ORLC	β=-0.13; p=0.032	β=0.43; p=0.00	β=0.047; p=0.38	β=0.04; p=0.52	No mediation		NS
H3	MP-TMC-ORLC	B=0.19; p=0.03	β=0.43; p=0.00	β=0.21; p=0.00	β=0.13; p=0.03	Partial	0.005	S

Addressing H1, we first regressed TMC on CP (path A). We observed that CP has a significant influence on TMC (β=0.16; p=0.00). The next step was the CP construct (path C), which showed significant effects on ORLC (β=0.2; p=0.00). The third regression was ORLC on TMC and CP (paths B and D). Path D is the direct effect of CP on ORLC (β=0.11; p=0.04), thereby controlling for TMC. Note that direct effect C is equal to the direct effect D plus the indirect effect (A times B). The significance of the mediation was determined with the Sobel test (Sobel, 1982). We found support for H1. This results supports prior research (see, Clemens and Douglas, 2006; Colwell and Joshi, 2013).

For H2, we first regressed TMC on NP (path A). We observed that NP has negative influence on TMC (β=-0.13; p=0.032). The next step was NP construct (path C), which showed insignificant effects on ORLC (β=0.047; p=0.38). The third regression was ORLC on TMC and NP (paths B and D). Path D is the direct effect of NP on ORLC (β=0.04; p=0.52), thereby controlling for TMC. However, we found no support for H2. This finding may open further debates. Hence in a similar vein to Clemens and Douglas' (2006) arguments, we need to investigate in context of normative pressures.

Similarly addressing H3, we first regressed TMC on MP (path A). We observed that MP has significant influence on TMC (β=0.19; p=0.03). The next step was MP construct (path C), which showed insignificant effects on ORLC (β=0.21; p=0.00). The third regression was ORLC on TMC and MP (paths B and D). Path D is the direct effect of MP on ORLC (β=0.13; p=0.03), thereby controlling for TMC. We found support for H3. This results support prior literature (see, Bansal, 2005; Colwell and Joshi, 2013).

Next addressing H4, we tested using hierarchical multiple moderation regression (see Table 6). The supply base complexity shows significant effects on the path connecting TMC and ORLC (β=0.54; p=0.00). We found support for H4.

Table 6: Hierarchical Moderated Regression Results for ORLC

Variables	Control Model	
	β	t
Controls		
Organizational size	0.01	0.17
Organizational compatibility	0.64	10.80
Interaction effects		
TMC*SCBC	0.54	4.78
Model Summary		
R^2	0.61	
Adj R^2	0.60	
Model F	67.23	
ΔR^2	0.2	
ΔF	7.2	

6. Discussion

6.1 Empirical and Theoretical Implications

The institutional theory argues that the drive for legitimacy that triggers the processes of institutionalization eventually makes organizations similar without necessarily making them more efficient, giving rise to institutional isomorphism (DiMaggio and Powell, 1983). Institutional theory has attracted significant support from leading scholars (see Heugens and Lander, 2009). However, unlike any other theories the institutional theory has attracted criticisms from various scholars. Following Greenwood and Hinings (1996) we note some gaps in the institutional theory. Colwell and Joshi (2013) have attempted to address the gap by arguing the role of top management commitment in translating external pressures on corporate responsiveness towards environment. However, we argue that supply chain is a complex network of players which may vary in terms of for instance culture, due to geographic dispersion. Further, Choi and Krause (2006) argue that the differences in terms of cultural, practical and technical aspects may further increase complexity. Following Sousa and Voss (2008), we ground our arguments in the view that if the role of top management is examined using the contingent theory lens, then we may get better explanation for performance in different situations which Colwell and Joshi (2013) have not included in their research model. By examining the moderating role of supply base complexity on the link between TMC and ORLC, we extend the work by Colwell and Joshi (2013). Hence, this study attempts to address Greenwood and Hinings' (1996) concerns related to the use of institutional theory. We argue that integration of three independent theories, that is, institutional theory, agency theory and contingency theory may offer better explanation to the efforts of organizations to minimize the impacts of carbon emissions in supply chain on environment. Our study, therefore, makes two important contributions to the existing literature. Firstly, we explain the mediating role of top management commitment on the role of institutional pressures on organizational response towards the environment. Secondly, we argue how supply base complexity may moderate the effect of top management on performance.

6.2 Managerial Implications

Our findings may offer interesting insights to managers and environmental consultants. The mediating role of top management commitment clearly suggests the role of the top management team in crafting the vision and translating it into desired success. We note that many organizations, despite their acquisition and use of resources, have failed to align their philosophy in light of the institutional pressures and finally disappeared in the intense competitive era. The role of supply base complexity further provides interesting insights into how managers can positively utilize the suppliers' diversity in terms of culture, linguistics and geographical diversity to address the carbon footprint issues. Our results further indicate that the influence of TMC on ORLC is moderated by supply base complexity. Managers should treat these complexities as a source of competitive advantage.

6.3 Limitations and Future Research Directions

Firstly, the current study utilizes cross-sectional data. We note this as one of the limitations of our study. To further advance our study, we recommend further study using longitudinal data. Secondly, we were unable to include supplier-supplier relationships due to data collection limitations. However, we believe that by using network data the supplier-suppler relationship can be studied further in relation to supply base complexity. Thirdly, we used the institutional theory perspective to understand how organizations respond to the institutional pressures. However, we believe that in future we can explore the organizational response towards low carbon emission (ORLC) using strategic choice theory to understand how different types of firms will respond to environment uncertainties. Finally, we observed some limitations in our research design. We believe future studies may benefit from the use of mixed research design (Boyer and Swink, 2008), such as the use of simulation to understand the role of supply base complexity resulting from supplier-supplier relationships in the absence of network data. Similarly, use of multiple case studies may help to build comprehensive theories (Pagell and Wu, 2009). Finally, whereas supply base complexity is utilized as a contingent factor within this research, other factors that might moderate the relationship between TMC and ORLC could be examined in future research. We believe, however, that we provide food for thought to those researchers and practitioners who would like to further explore the antecedents of low carbon emissions in the supply chain.

7. Conclusion

Drawing broadly on institutional theory, the influence of top management commitment, the contingent effects of supply base complexity and the literature on organizational response towards carbon emissions in supply chain, we developed and tested a theoretical model using cross-sectional data gathered by a pre-tested survey instrument conducted with Indian manufacturing organizations. The hypotheses tests conducted using multiple regression analyses support our research hypotheses except hypothesis H2. The study result supports our argument that under the mediation effect of top management commitment, the CP and MP has positive impacts on ORLC. Hence our result is a call for further investigation in context of lack of support which runs contrary to Colwell and Joshi's (2013) findings. The moderating role of supply base complexity on TMC further highlights the need for strategies to exploit the conditions to produce better performance. Notwithstanding the limitations of this research, our study can be taken to the next level using the research directions we have identified.

Appendix: Factors Structure

	Constructs							
	CP	NP	MP	TMC	SCBC	ORLC	OC	
CP1								
CP2	.844							
CP3	.798							
CP4	.601							
NP1		.707						
NP2		.872						
NP3		.831						
MP1			.747					
MP2			.783					
MP3			.828					
TMC1								
TMC2				.882				
TMC3				.814				
TMC4				.694				
SCBC1					.756			
SCBC2					.737			
SCBC3					.768			
SCBC4					.615			
SCBC5					.843			
SCBC6					.745			
ORLC1						.666		
ORLC2						.544		
ORLC3						.897		
ORLC4						.919		
ORLC5						.810		
OC1							.695	
OC2							.857	
OC3							.849	
Eigen Value	1.71	1.95	1.86	1.92	3.35	3.05	1.94	15.78
%	6.58	7.51	7.14	7.40	12.88	11.72	7.46	60.68

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