Exploring the influence of Environmental Uncertainty and Supply chain practices

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Abstract

External environment determines to a large extent, the practices that organizations adopt, to remain competitive in the market. According to the environment-strategy-performance theoretical framework, environmental factors are important determinants of a strategy choice, organizational structure and processes of the firm. Although, there is a strong theoretical and empirical support for the environment-strategy-performance relationship, the review of the Supply Chain literature indicates that there is a need for more recent studies that examine this relationship for today's companies that operate under highly turbulent and competitive market conditions. Hence, the current study intends to explore the influence of Environmental Uncertainty and Supply Chain Practices on Supply Chain Performance in the Coir industry in India. This study explores this topic further by analyzing the part played by Environmental Uncertainty variable as an antecedent of Supply Chain Performance, and Supply Chain Practices as a mediator construct. Using partial least squares (PLS), we find evidence of these relations proposed. The study was conducted using direct interview with the help of standard scales among 78 respondents. SEM was used for analysis of the data. The study found that Environmental Uncertainty enhances Supply chain performance by positively influencing the adoption of Supply chain practices. The study not only reinforces the earlier researches on the role of Supply chain practices in influencing supply chain performance, but also brings out its significant role in improving Supply chain performance even under Environmental Uncertainty.

Key words: *Environmental Uncertainty, Supply Chain Practice, Supply Chain Performance, Environment-strategy framework.*

Businesses today are experiencing increasingly competitive business environment as a result of globalization, advancement of information and communication technologies, and turbulent market place. One of the most widely accepted definitions of the environment in strategic management is that it is a set of relevant factors outside the organization that must be considered in decision making (Duncan, 1972). Thus, the environmental characteristics largely influence the strategic behaviour of businesses (Fahey and Narayanan, 1986; Sutcliffe and Zaheer, 1998). Environment is also an imperative factor, that determines the level and extent of collaboration among the members of supply chains (Balakrishnan and Wernerfelt, 1986; Zenger and Hesterly, 1997).

Uncertainty is an important indicator of how an external environment may influence an organization (Lewis and Harvey, 2001; Ondersteijn et al., 2006) and is defined as the lack of information about environmental factors involved in a decision-making situation (Duncan, 1972). Environmental uncertainty poses challenges for supply chains, and business leaders recognize they need to take action to manage it. Because supply chain flexibility is a main driver of supply chain performance (Vickery et al., 1999; Stevenson and Spring, 2009), firms emphasize supply chain flexibility more in times of increased uncertainty (Swamidass and Newell, 1987). Supply chain flexibility improves the performance of supply chains mainly through logistical efficiency and effectiveness (Omar et al., 2012).

Very little research has been done on the influence of Supply chain practices on Supply chain performance in the presence of Environmental uncertainty. The rest of the paper is organized as follows: Section 2 describes the review methodology, Section 3 draws out the theoretical development Section 4 explores the relationship between the constructs. Section 5 concludes and suggests future research directions.

Supply Chain Management

Sahay (2003) pointed out that effective supply chain management (SCM) can make or break a company. Apple, Amazon, Dell and P&G are some of the top companies making use of effective supply chain strategies and enjoying competitive advantages in the marketplace, both in terms of cost and customer satisfaction. In order for the supply chain to perform effectively, good supply chain practices are to be in place. Supply chain practices vary with industry and organizations. Adoption of the same is influenced by environmental uncertainty and disruption factors which may also lead to variations in supply chain performance. Hence a research framework has been developed describing the causal relationship between these constructs with a comprehensive literature review. The three proposed constructs in the model include Environmental Uncertainty, Supply chain Practices and Supply chain performance.

Environmental Uncertainty

Environmental uncertainty refers to events and variables that have a random and unpredictable variation, impacting the very existence of a business (Lenz 1980). Some researchers classify uncertainty on the basis of the source of the uncertainty. Miller and Droge (1986) have classified uncertainty into the following five sub dimensions - volatility in marketing practices, product obsolescence rate, unpredictability of competitors, unpredictability of demands and tastes, and change in production or service modes. Gupta & Wilemon (1990) proposed four uncertainty factors- 1) increased global competition, 2) continuous development of new technologies that quickly cause existing products to be obsolete, 3) changing customer demand needs and requirements which truncate product life cycles, and 4) increasing need for involvement of external organizations such as suppliers and customers. Li Suhong 2002, Zhang 2001, Ettlie and Reza 1992, envision uncertainty as unexpected changes in customers, suppliers, competitors, and technology. Davis (1993) suggests that there are three different sources of uncertainty in supply chains: demand uncertainty, supply uncertainty and technological uncertainty.

Supply Chain Practices

Supply Chain practices integrate between business units, suppliers and customers in order to promote effective SCM (Khang et al., 2010). Supply Chain practices are defined as "the set of activities undertaken in an organization to promote effective management of its supply chain" (Donlon, 1996, Li et.al. (2006,2005). Donlon (1996) outlined four dimensions in supply chain practice such as supplier partnership, outsourcing, cycle time compression and information technology sharing. Li et. al.(2005) has put forward a validated measure for studying Supply chain practices, with six dimensions: 1) strategic supplier partnership, 2) customer relationship, 3) information sharing and 4) information quality, 5) internal lean practices and postponement.

Supply chain performance

SC performance is defined in the existing literature as the extent to which the supply chain is able to meet customer requirements with on-time delivery (Tarafdar and Qrunfleh 2016, Li et al. 2002, Beamon 1999). A trend of increasing attention on Supply chain performance, both in practice and literature, are emphasized in the works of Gunasekaran and Kobu (2007). Their review classifies the literature based on the following criteria: balanced scorecard perspective, components of measures, location of measures, decision levels, nature of measures, measurement base, traditional versus modern measures. This idea is also supported by McCormack et al. (2008). Rexhausen et al. (2012) proposes supply chain cost, service level and flexibility as SC performance measures.

RESEARCH GAP

Very little research has been done in India on the impact of Environmental Uncertainty and Supply Chain Practices on Supply Chain Performance. Most of the worldwide studies have considered very large firms. This has left a gap in the studies done in small manufacturing and traditional sectors in India. There has hardly been any research aimed at building and validating theoretical models in India pertaining to Environmental Uncertainty. This research aims to validate a comprehensive supply chain model for the Coir Industry in India, which is a traditional industry under the MSME ministry.

DEVELOPMENT OF A CONCEPTUAL MODEL

Influence of Environmental Uncertainty on Supply chain performance is explored through the theoretical lens of existing research studies on Supply Chain Practices.

Environmental Uncertainty and Supply Chain performance

Davis (1993) suggests that there are three different sources of uncertainty in supply chains: demand uncertainty, supply uncertainty and technological uncertainty. Demand uncertainty refers to the unknown or unpredictable variations in the quantity and timing of demand as experienced in a supply chain. The characteristics of demand uncertainty are defined by the amount of forecast error (the difference between actual demand and forecast demand). Two inter-related factors, quantity uncertainty and timing uncertainty can influence this forecast error and lead to either excess inventory or shortages.

Supply uncertainty is similar to demand uncertainty in that it relates to the unpredictable nature of the quantity of timing and supply. It can occur as a result of manufacturing downtime, quality and yield problems, order-entry errors, forecast inaccuracies or logistical malfunctioning (Davis, 1993). Walker and Weber (1987) support this argument in their study of the US automobile industry. They conclude that costs such as switching suppliers and adjustment costs in response to change in volume or product specification may occur as a result of opportunistic supplier behaviour. Firms with newer technologies undergoing rapid change are expected to benefit more from positive SC relationships than those with stable technologies (Slater and Narver, 1994). Indeed, truly innovative products often rely on emerging technologies that require clarification and assistance during diffusion. When technology is changing rapidly, the firm must be able to share information more quickly than when technology is more predictable. Stronger SC relationship quality between parties should facilitate improved SC performance in these turbulent environments. Firms need to interact when technology is stable, but SC relationships can be expected to play a more important role when technological change is rapid. The above arguments lead us to the following hypothesis.

H1: As Environmental uncertainty increases, the Supply chain performance also increases.

3.2 The mediating role of Supply Chain Practices in the relationship between Environmental Uncertainty and Supply chain performance.

Environmental uncertainty has been well recognized as an important driver for an organization to adopt supply chain practices (Franks 2000; Chandra and Kumar 2000; Claycomb et al. 1999). As the markets become more and more uncertain, firms resort to various practices like better supplier relations, more information sharing, lean practices and better logistics to reduce the impact of the uncertain markets. Firms resort to better supplier partnerships so that suppliers will be more understanding and will cooperate in changes in delivery schedules, product specifications, payment schedules, etc. (Lambe and Spekman 1997). In industries having short technology cycles, there is a risk of component obsolescence. So firms need strong relations with suppliers to avoid stagnation of unnecessary spares at any stage of the supply chain (Mentzer et al. 2000). In highly competitive industries, a firm faces threats from competitors who try to introduce products faster and with more features. Degree of collaboration within the supply chain impacts the overall supply chain performance. Strategic supplier

partnership is long term cooperation between the firm and its suppliers aimed at achieving increased productivity and efficiency at both ends (Monczka et al. 1998; Stuart 1997). Customer Relationship is the set of practices that binds the firm to its customers aiming to build customer satisfaction and loyalty (Tan et al. 1998; Claycomb et al. 1999; Agarwal 1997). The financial survival of firms is going to depend on better customer relations (Wines 1996). The major aspect of good customer relationship is the understanding of the requirements of the customer without his explicitly mentioning it. This enables the firm to respond better than others to customer requirements and needs and hence provide best value to customers, thus creating lasting loyalty (Magretta 1998). Information Sharing refers to the amount of sensitive information that is willingly shared among partners (Monczka et al. 1998). It has been identified as a vital element linking the constructs of collaboration/ integration and risk/performance. External supplier-facing integration has a strong influence on customer performance (Kache & Seuring, 2014). Influence of Information sharing on performance, responsiveness and flexibility in supply chain has been put forward in the studies of Zhang et al., (2011). Information sharing is critical if the entire supply chain is to function seamlessly (Towill 1997, Balsmeier and Voisin 1996). Most of the information shared today is strictly on a need to know basis only (Berry et al. 1999). But contrary to all popular notions good information exchange actually improves competitive advantage and productivity (Alvarez 1994). Too much of information can also drown the decision makers with a tonne of facts, thus confusing them. So good information should be concise and to the point (Li 2002). Information Quality refers to the accuracy, adequacy, timeliness and credibility of information being exchanged among trading partners (Monczka et al. 1998). Lean System is the practice of improving productivity to enable a reduction in inventories across in the plant and hence across the supply chain. Lean involves the elimination of seven types of wastes from the entire supply chain (Taylor 1999). Womack and Jones (1996) identified five principles of waste elimination in organizations. Logistics practices are the practice of working jointly with logistics providers with a long term perspective to improve supply chain cohesiveness (Bechtel and Jayaram 1997) Logistics act as glue connecting various entities in the supply chain. Logistics deals with the movement of materials and goods among the different players in the supply chain. The above arguments lead us to the following hypothesis:

H2: The relationship between Environmental Uncertainty and Supply chain performance is

mediated by Supply Chain Practices.

RESEARCH DESIGN

This research is set in the context of the Kerala and Tamil Nadu based Coir manufacturers and exporters. 94% of the Coir firms in India are located in these two states. The research required direct interview with the Proprietor/Director/Chairman/General Manager /top officials of the firms. Thus a cross-sectional survey design was the best suited for the purpose. The advantages of this research design are that it is economical and consumes less time. The major disadvantages of this research design, however, are the lack of control over environmental factors and the inability to study the process over time. (Babbie, 1989).

Coir firms which were not registered under Coir Board, cottage based units and those which are involved only in trading and exporting were not considered. Out of the 701 Coir exporters, only 247 firms all over India, qualified for the survey. Out of which, a cluster consisting of Kerala and Tamil Nadu are selected for the survey. Kerala and Tamil Nadu were selected as the places for data collection as Total Sample Size: 78 (Power analysis was used to calculate the sample size(G Power 3 software) based on significance level used, power of the test and measure of effect size). Multi-stage random sampling was employed. Purification and Construct Reliability of Scales (using SPSS 20), Path analysis using Warp PLS. Warp PLS is a statistical software package used to do path analysis in social science research.

For measuring the variables Environmental Uncertainty, Supply Chain Practices and Supply Chain Performance, scales used in previous studies were adapted. (i) Environmental Uncertainty consists of 18 item construct developed by Li et al. (2002), (ii) Supply Chain Practices is a second order construct with six sub constructs developed by Li et al. (2002), Supply Chain Performance uses scales developed by Rexhausen et al.(2012) and Vicekry et.al.(1999).

Data analysis

The data collected was screened for missing values and normality. A reliability analysis was done, the high values of reliability coefficient emphasized on the appropriateness of the indicators. Scales were purified and then the data was analyzed. To analyse causal relationships between the constructs, the structural equation modeling approach was

adopted. We have used Partial Least Squares (PLS) (Roldán & Sánchez-Franco, 2012) for path modeling to test the research model.

Supply chain practices are hypothesized to mediate the relationship between Environmental Uncertainty and Supply chain performance variables and this is tested by using Baron & Kenny's (1986) criteria. First, two models were built. The first model had Environmental Uncertainty pointing at Supply chain performance without Supply chain practices being included in the model. The second model had Environmental Uncertainty pointing at Supply chain performance, Environmental Uncertainty pointing at Supply chain practices and Supply chain practices pointing at Supply chain performance. This is a "triangle"-looking model(Figure 2). A WarpPLS analysis was conducted with both models.

RESULTS

Measurement model

First, the indicators and dimensions satisfy the requirement of reliability since their loadings are, in general, greater than 0.7 (Table 1). In order to accomplish this result, an item trimming process was carried out with some weak items of the instrument being excluded. Loadings for constructs are only shown due to space constraints. Second, all multidimensional constructs and dimensions meet the requisite of construct reliability, because their composite reliabilities (CR) are greater than 0.7. Third, these latent variables attain convergent validity since their average variance extracted (AVE) surpasses the 0.5 level or are very near to it (Table 1). Lastly, Table 2 shows that all variables achieve discriminant validity following the Fornell-Larcker(1982) criterion, however, the Supply chain practices variable may have a discriminant validity problem.

Sl. No.	Construct	Loading	CR	AVE
1	Environmental Uncertainty	.858	.972	.747
2	Supply Chain Practices	.770	.912	.655
3	Supply Chain Performance	.980	.996	.977

Notes: CR: Composite Reliability, AVE: Average variance extracted

Table2: Discriminant validity of Measurement model (Fornell-Larcker Criterion)

	EU	SCPrac	SCPerf
EU	**.865**	.224	.305
SCPrac	.224	**.809**	.935
SCPerf	.305	.935	**.988**

Notes: EU: Environmental Uncertainty, SCPrac: Average variance extracted, SCPerf: Supply Chain Performance. Fornell-Larcker Criterion: Diagonal elements (bold) are the square root of the variance shared between the constructs and their measures (AVE). Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

Structural model

Table 3 includes the main parameters obtained for the two models under study in the structural assessment. Model 1 describes the significant total effect (β = 0.72*) of Environmental Uncertainty on Supply Chain Performance. Model 2 shows how the direct effect of Environmental Uncertainty on Supply Chain Performance decreases, although it remains significant (β' = 0.23**), when Supply Chain Practices are included. This supports H1. Furthermore, paths a (β between EU and SCPrac) and b1

(β between SCPrac and SCPerf) are significant. Therefore, both the decrement manifested in the direct effect (β') and the significance of the regression coefficients a and b1 would be suggesting the potential existence of an indirect effect of Environmental Uncertainty on Supply Chain Performance via Supply Chain Practices as a mediator (H2). The mediating effect was found to be significant as the three following criteria are met: In the first model(Figure 1), the path between Environmental Uncertainty and Supply chain performance was found to be significant ($p < 0.01$). In the second model (Figure 2), the path between Environmental Uncertainty and Supply chain practices is significant. In the second model, the path between Supply chain practices and Supply chain performance is significant. Here, the effect of Environmental Uncertainty on Supply chain performance in the second model is significant; hence the case is one of "partial" mediation.

Table 3: Structural model results

Relationships	Model 1 R^2_{SCPerf}=0.53	Model 2 R^2_{SCPrac}=0.31 R^2_{SCPerf}=0.93
H1:EU → SCPerf	0.72*	0.23**
EU → SCPrac = a		0.56*
SCPrac → SCPerf = b1		0.81*

Notes: *p<.01, **p<.05

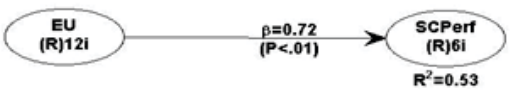

Figure 1 – Model with a direct effect model

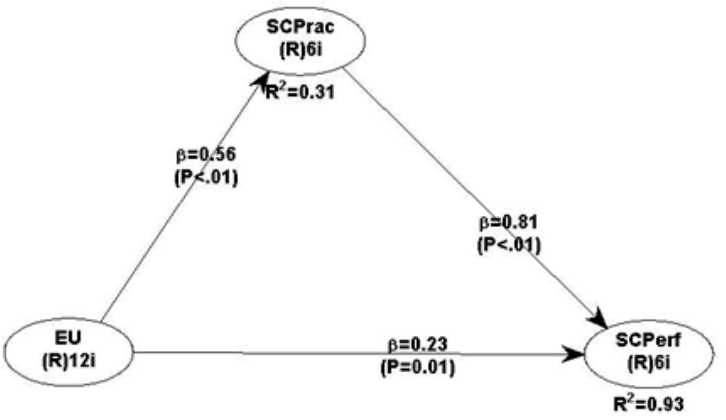

Figure 2 – Model with an indirect effect

DISCUSSIONS AND CONCLUSIONS

The study could empirically explain the environment-strategy-performance framework in the Coir industry context. All the hypotheses tested were found significant and the causality assumptions were found statistically valid. The results of the model estimates revealed the relative importance of each of the dimensions that contribute to Supply chain performance. The study statistically established that Environmental uncertainty and Supply chain practices are a significant factor that influence Supply chain performance, with Supply chain practices playing a mediating role. As Environmental uncertainty increase, Supply chain performances also seem to increase, which could be the result of adoption of more Supply chain practices by the firms. This reinforces the importance of Supply chain practices that firms need to follow, in an environment of uncertainty, failure of which may result in low Supply chain performance.

FUTURE RESEARCH DIRECTION AND CONCLUSION

The management of a highly interconnected supply chain is an ever-increasing challenge in today's competitive business environment. Higher levels of uncertainty in supply and demand, shorter technology and product life cycles, globalization of the market, and the increased use of distribution, manufacturing, and logistics partners all results in a complex international network. Given the complexity of many supply chains, experiencing uncertainty is recognized by many organizations as being inevitable. In a volatile supply chain, effectively managing and mitigating risk and uncertainty is imperative by adopting suitable SC practices, which would lead to performance improvement. The current study can further be extended to empirically examine the validity of the proposed model in any industry. An end to end study on any Supply chain could also throw light on the significance of the model.

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