



Impact of Uncertainties on Supply Chain Operations in Pakistan

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ABSTRACT

Uncertainties are an inherent part of doing business and are dealt with relatively high degree of confidence. Uncertainties pose a variety of risks that can even pull down the organizations. This study has determined the impact of the general uncertainties and its possible minimization. Uncertainties are quite ambiguous for e.g. political upheavals, natural disasters, which cannot be predicted and create impulsive fall-outs for the supply chain process for any business. However, results found that organizations face major disruptions in supply chain operations when uncertainties are caused and it mainly damages the overall revenue score of the product/service, if the organization has no contingency planning system.

Keywords: Supply chain operations, micro-level uncertainty, macro-level uncertainty, uncertainty cycle

Introduction

Overview

From the supply chain perspective, questions like “how many customers can be served from the available stock?” help a business assess an uncertain factor and in turn help in avoiding the shortages and stock-outs. When the product variety is large, products are directed using a large number of marketing channels and with wide variations in the range of quantity required, the supply chain further faces additional uncertainties, which needs to be addressed (Vorst, Beulens, De Wit, & Beek, 1998).

Making risk assessment, mitigation plans and control is an essential part of the supply chain management to avoid uncertainties and major revenue losses in the organization.

Furthermore, in a business environment uncertainties are caused due to lack of demand and supply or surplus of demand and supply of any product, political instability, critical law and order situation and other miscellaneous resources unavailability, which brings supply chain operations in a menace.

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This uncertainty, described by Chopra and Meindl (2012) is an implied demand uncertainty, this introduces more concern for the supply chain managers. In order to assess these uncertainties of demand, companies keep a buffer stock which adds to their costs of doing business. Moreover, seasonal products have a short selling period, where demand for the season has to be met from the stock created based on the anticipations of seasonal demand (Sanchez-Rodrigues, Potter & Naim, 2010). If the demand is overestimated then the company will have to sell the stock at the end of the season to dispose of the inventory and if the demand is underestimated then the customer service level (as well as profitability) of the organization will be compromised.

Uncertainties make an organization modify its strategies according to the situation. A high demand uncertainty makes an organization to not only modify production but also the storage operations and in some cases even the logistics. The study will help explore the various uncertainties in order to overcome the specific situations, since no single strategy can be implemented in all of the organizations in the same situation.

The purpose of this research study is to identify whether an uncertainty impact negatively on the supply chain activities of the organization in Pakistan.

Literature review

Uncertainties in the realm of supply chain (SC) expose the business to extreme risks. These uncertainties can be damaging to the supply chains with consequences that restrain businesses from being able to serve their customers and at other times make businesses end up with excessive inventories due to the bullwhip-effect. Therefore, SC must plan their strategies to counteract these challenges.

A study by Dumke (2011) assessed the seasonal demand uncertainty, which is an example of SC practice. The seasonal demand uncertainty was due to sudden change in weather conditions, which brought the ice cream business and clothes business in an extreme uncertain demand. This badly impacted the efficiency of SC and the overall business operations of the ice-cream and clothes business.

Types of Uncertainties

Uncertainties range from the general variations in forecasted and actual values to the chaotic circumstances where, uncertainties remain unstructured and unplanned for events like terrorism, political crises and natural disasters (Vilko, Edelmann, & Hallikas, 2010).

Table 1: Types of uncertainties in supply chain

Macro-level uncertainties	Micro-level uncertainties	Description
General variation	Variable	There are distinct differences between forecast and actual measured values
General variation	Multiple goal	Several planning goals may or may not be mutually supportive
General variation	Constraint	This is related to the previous issue of multiple goals. In a multiple goal environment, some possible solutions may be available if constraints are relaxed. Without relaxing them, some possible solutions may be eliminated
Foreseen uncertainty	Amplification (or bullwhip effect)	As systems become increasingly more complex, this self-same complexity leads to uncertainty in information, forecasting and inventories because of the nature of the feedback system
Foreseen uncertainty	Parallel	Bullwhip effects are serial interactions in the supply chain. However, parallel effects occur because the supplier in each tier also interacts with other channels in the supply chain. These interactions within a single tier can directly affect the traditional, serial interactions of a supply chain

Macro-level uncertainties	Micro-level uncertainties	Description
Unforeseen uncertainty	Deterministic chaos	As opposed to general non-deterministic chaos, deterministic chaos has bounded dynamics within a deterministic system. There is sensitivity to initial conditions, but the "chaos" still has structure
Unforeseen uncertainty	Long-term planning	You cannot assume that traditional optimal/near optimal techniques can be applied to long-term supply chain planning that is strictly uncertain (i.e. inherently non-deterministic)
Chaotic uncertainty	General non-deterministic chaos	Totally unplanned and unstructured events require systems that can constantly adapt to changing environmental extremes

*Source: Prater, E. (2005). A framework for understanding the interaction of uncertainty and information systems on supply chains

Table 1 shows the various types of uncertainties commonly encountered by the supply chains Prater (2005) also classifies the uncertainties into macro and micro level uncertainties as given below:

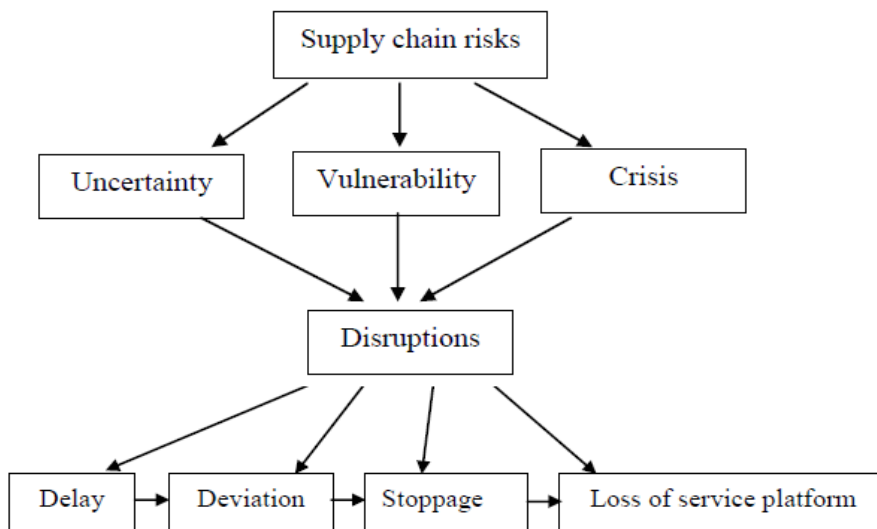
Table 2: Macro and Micro level of SC uncertainties

Macro Level	Micro Level
General Variation	Variable, multi-goal and constraints
Foreseen Uncertainty	Amplification and parallel
Unforeseen Uncertainty	Deterministic chaos and long-term planning
Chaotic Uncertainty	General non-deterministic chaos

*Source: Prater, E. (2005). A framework for understanding the interaction of uncertainty and information systems on supply chains

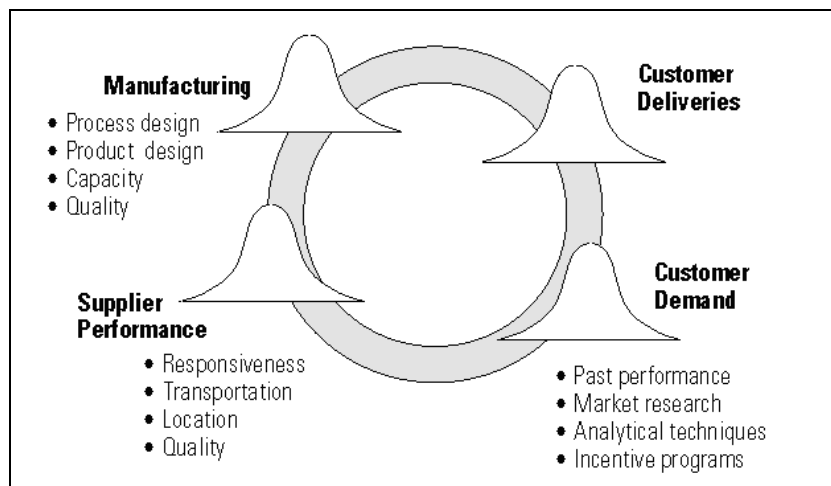
Courtney, Kirkland, and Viguerie (1997) argued that uncertainties fall into two main areas; first are the uncertainties that can be analyzed based on the market trends while second being the market elasticity of demand. Courtney et al., (1997) describes these as uncertainties quantifiable from analysis. The other uncertainties were considered as residual uncertainties and were divided into the four types, based on their future outcome:

1. Uncertainties with clear enough future
2. Uncertainties with alternate future
3. Uncertainties with a range of future
4. Uncertainties with true ambiguity

Figure 1: Supply Chain Risks and Consequences

*Source: Gurning (2011). Maritime disruptions in the Australian-Indonesian wheat supply chain: An analysis of risk assessment and mitigation strategies.

Figure 1 shows the types of supply chain risks and its consequences (Gurning, 2011). Identifying the type of uncertainty is the initial step for the formulation of effective supply chain plans and counter measures. Whereas, the following uncertainties can be dealt with: uncertainties with clear enough future, uncertainties with alternate future and uncertainties with a range of future as outlined in the above-mentioned literature (Courtney, Kirkland, & Viguerie,1997).

Figure 2: Cycle of Uncertainties

In the above Figure 2, Davis (1993) described a cycle of uncertainties in the supply chain where uncertainties lie in the factors of supply, manufacturing and customer demand.

Impact of Uncertainties

As Figure 1 shows the impact of uncertainties may vary from delays, deviation and stoppage of the service. Butcher (2011) described the impact of uncertainties as adding to the cost of operations; generating the need to increase inventory levels and maintain a higher lead time

in order to serve the customers without any delay. Butcher (2011) further argued that the inability to analyze the past data and a failure in development of a good forecast adds up to the uncertainties.

The uncertainties shown in Figure 2 can be reduced at each stage of the uncertainty cycle; whereas, good analytical tools can improve the forecast, reliable suppliers can minimize supply uncertainties, the Total Quality Management approach can help reduce the quality related uncertainties and uncertainties attributed to the manufacturing process can be reduced by devising a proper production design. However, not all uncertainties can be reduced or eliminated, and one can only plan to minimize the resulting impact (Davis, 1993).

Yi, Ngai, and Moon (2011) have studied the effect of uncertainties on the flexibility in supply chains of the apparel industry. It was found that the perceived uncertainties of demand, supply and that of competitive nature could affect the flexibility of a supply chain.

Furthermore, demand uncertainties include an emergent order: product forecast error and product deterioration. Supply uncertainties include reliability of material quality, supplier lead-time, supplier responsiveness and material costs. Competitive uncertainties include competitor aggressiveness and low entry barriers. The surveyed companies indicate the solutions to counter act these uncertainties and to maintain desired flexibility, whereby the companies ensure that keeping a portfolio of multiple suppliers and upgrading it by changing the suppliers helps ensure flexibility of the input sourcing. To improve the operating system flexibility with regard to adjustment of production, outsource-service providers and new product development were focused upon. For the case of organizational flexibility, casual labor and external finance were used to overcome the related uncertainties.

Hypothesis

H₁: There is a negative effect of Uncertainty on the supply chain operations.

Research Methods

Method of Data Collection

The study incorporated primary data collection method and for the purpose Likert scale questionnaire was developed. The respondents were the supply chain key managers from different organizations across diverse industries from Karachi region only. The sample size was 200 respondents. The questionnaire consisted of 10 questions in relevance to the impact of Uncertainty on supply chain operations. Regression analysis was used to assess the impact of the explanatory variable on the dependent variable.

Results

The data collected from the survey was analyzed using the OLS model. The regression outcomes explain the effect of explanatory variable (Uncertainty) on the dependent variable i.e. supply chain operations.

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.696 ^a	.485	.481	.43070
a. Predictors: (Constant), Uncertainty				
b. Dependent Variable: Supply Chain Operations				

Table 3 and 4 show that 48.5% of the variation is explained by the model at $F > 3.84$. It shows that model is significant but does not determine all the causes that lead to variation in the supply chain operations.

Table 4: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.063	1	24.063	129.718	.000 ^a
	Residual	25.600	138	.186		
	Total	49.663	139			

a. Predictors: (Constant), Uncertainty

Table 5: Coefficients

Model		Un-standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.314	.218		6.042	.000
	Uncertainty	-.664	.058	-.696	-11.389	.000

a. Dependent Variable: Supply_Chain_Operations

In the table given above (Table 5), findings of this paper further revealed that the Uncertainty negatively affects the supply chain operations as beta was found 0.664 at $t > 1.5$. Hence we failed to reject the hypothesis i.e. there is a negative effect of Uncertainty on the supply chain operations.

Discussions, Conclusion, Policy Implications and Future Research

The previous studies show that if organizations have contingency planning to avoid risks and unforeseen damage, the impact of the uncertainty can be minimized to a certain extent. We also know from our practical witnessing that uncertainties such as political upheavals and major natural disasters cannot be predicted and hence, impact on the businesses and on the supply chain operations of the business. However, companies with good plans, buffers, and measures have a better chance at surviving these totally unpredictable events. This study found that uncertainties are damaging the supply chain operations in Pakistani organizations but nevertheless can be controlled and managed with effective planning and strategic tools available to SC managers. Also, it is important to mention that the uncertainties like city disturbance due to terrorism, political instability has increased in these years. The findings approved that organizations face crisis due halt in their supply chain operations.

Mukherjee (2008) cites the classical example of SC uncertainty, where a fire caused by lightning in a clean room at a Philips plant located in Albuquerque (USA) altered the course of the cellular-phone industry. Philips was a key supplier of silicon wafers to both Nokia and Ericsson. Nokia was quick to find alternative silicon-wafers suppliers and continued working with Philips to help resume its supply of silicon-wafers and on the other hand, Ericsson immensely overlooked the problem. The strategic counter measures resulted

in Nokia's survival in this ambiguity, while Ericsson fell into serious financial problems and eventually had to seek help from Sony and subsequently became Sony-Ericsson. This case showed that an extensive forward-planning can help drive the calamity and restore the supply chain operations.

The study concludes that uncertainties represent grave damages (varying in magnitude) for supply chain operations. Uncertainties help the organizations modify their supply chain strategies according to the situation that the organization may face. The research demonstrates that uncertainties have a negative impact on the supply chain operations in Pakistan although with proper planning and due attention, the disruption could often be turned into opportunity, which can be easily handled by big organizations. The medium and small organizations have other factors (cost to acquire SC experts, less human resource, technical expertise etc), which do not enable them to handle risks or positively react to the risks.

Unfortunately, in the present circumstances, supply chain operations of organizations in Pakistan are facing more than their fair share of major uncertainties such as terrorism, floods, earthquakes, political instability and critical law and order situation.

For further analysis, case studies on different organizations in relation to their supply chain operations can be researched upon to explore as to how the supply chains that face challenges hold up and survive in the face of these events.

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