IMPACT OF SUPPLY CHAIN UNCERTAINTY ON BUSINESS PERFORMANCE AND THE ROLE OF SUPPLIER AND CUSTOMER RELATIONSHIPS: COMPARISON BETWEEN PRODUCT AND SERVICE ORGANIZATION

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ABSTRACT

This paper investigated the relationships between supply chain uncertainty, supply chain relationships and firm’s performance in product and service industries. The results show that in both industries, supply uncertainty is a more significant determinant of performance than demand uncertainty. In product industry, uncertainty can be reduced by being more closely aligned with both suppliers and customers, while in service industry this does not appear to be the case.

Keywords: supply chain uncertainty, supply chain relationship, product and service supply chain

INTRODUCTION

Researchers generally agree that uncertainty is a major driving force behind the effective establishment of supply chain relationships [1-3]. Williamson (1979) clearly stated when he classified types of organizational relationships thus:

“the three critical dimensions for characterizing transactions are 1) uncertainty, 2) the frequency with which transactions recur, and 3) the degree to which durable transaction-specific investments are incurred. Of these three, uncertainty is widely conceded to be a critical attribute” [2 page 239]

Haunschild (1994) added that uncertainty prompts firms to search for information from others. Interorganizational relationships are recognized as a prime source of such information, establishing connections that will allow better information accessibility to facilitate decision making under uncertain conditions. The literature employs the term adaptability or stability to explain relationships that are caused by uncertainty [4]. This is because under uncertainty, firms establish interorganizational relationships to be able to adaptable to the environment and to be able to predict environmental change and promote stability in changing environments [3, 5].

While uncertainty is claimed to be a major driving force for the management of supply chain relationships, there has been limited amount of work that investigates the relationship between them particularly in relation to firm’s performance. Recently, Donk and Vaart (2003), in a review of supply chain integration literature, state:

“While these authors contribute to our knowledge of integration and integrative practices, little has been done by them or others to better understand the prevailing business conditions for certain integrative practices.” [6 page 97]
There has been some work done exploring the impact of the nature of supply chain relationships on firm’s performance, but outside the context uncertainty level [7-10]. The results from these studies have also been substantially different, and have so far not been sufficient to assist decision making in supply chain management.

Accordingly, this research will examine the relationship between supply chain uncertainty, nature of supply chain relationships and firm’s performance. By examining supply chain relationships in relation to supply chain strategy, the study seeks to advance the understanding of supply chain relationships in a broader context by covering both supplier relationship and customer relationship alignment. While existing studies mostly focused on product related industry, this study covers

**LITERATURE REVIEW**

A common theme in the literature is that internal demand fluctuations are the dominant source of uncertainty in supply chains [11-15]. Forrester developed the notion of amplification of behaviour from his feedback theory study in 1961. Feedback theory explains that information influences decision-making under systemic conditions, while simultaneously generating the actions intended to modify those system conditions [16].

Internal demand uncertainty occurs when information signals observed by supply chain members vary from the actual consumer demand. The major cause of variation is the overreaction of each decision maker in response to demand information [12, 15, 17]. For example, upstream members receive an order placed by a downstream member when that order has been continually adjusted and varied from the consumer’s demand based on the amount of safety stock added due to ordering policies. Higher numbers of decision makers and longer lead-times will result in higher demand fluctuations [15].

Demand uncertainty is also partially affected by trade deals that create forward buying, order batching that usually leads to a flood of product at one time in a period, and shortage gaming (e.g. retailer places extra orders based on their anticipation that suppliers will be in short supply [11, 12]).

On the supply side, Wilding (1997b) has demonstrated that internal supply uncertainty can be generated from parallel interactions when members at the same tier interact because of supply disruption. Others have also found that supply is uncertain because of the supplier performance. Hau L. Lee et al., 1997; Sterman, 1989; D. R. Towill et al., 1992.

In 1980, Buffa proposed that uncertain supply would be one of the issues for future research due to the scarcity of resources [18]. Many researches since then have been dealing with price, delivery time and quality variability on the supply side [e.g. 19, 20]. The use of partnerships, trust and alliances has been promoted in several studies [8, 21-25].

To explain the characteristics of different supply chain relationship patterns, the literature has defined the supply chain as a network of suppliers, manufacturers, distributors and customers. Thorelli (1986) noted that a supply chain network is formed when “two or more organizations are involved in a long term relationship” (p. 37).

According to Batt (2004), a supply chain network structure can be a complex set of systems, subsystems, operations, activities and interrelationships belonging to its various members.
These could include suppliers, carriers, manufacturing plants, distribution centres, retailers, and consumers. The networks of supply chain form inter-functional and inter-organizational relationships referred to as “Supply Chain Partnerships” [9, 26-28] “Supply Chain Value Networks” [29] “Strategic Alliances” [30], and “Value-added partnerships” [22, 31]. The importance of supply chain relationships has been identified by Handfield (1999) when they state that “without a foundation of effective supply chain organizational relationships, any efforts to management the flow of information or materials across the supply chain are likely to be unsuccessful” [32 p.9-10].

Supply chain relationships are a structural supply chain integration approach with the aim of maximising outcomes and performance for trading partners [33]. Supply chain benefits from managing inter-organizational relationships have been extensively documented. General benefits include cost reduction, product development improvement, cycle time reduction, and quality improvement [10, 28].

Although many researchers propose that partnership based relationships are superior to arm’s length [34, 35], an empirical study by Groves and Valsamakis (1998) on the performance comparison between different types of supply chain relationship (partnership, semi-adversarial, adversarial) found no link between tightened relationships and increased performance. That is, the study provides no evidence that partnerships ensure better performance than semi-adversarial and adversarial arrangements.

Thus, the aims of this study was to
1. investigate the impact of demand and supply uncertainty on business performance
2. observe whether level of supplier relationship and customer relationship have an impact on business performance
3. investigate whether the extent of supplier and customer relationship influence the level of demand and supply uncertainty

DATA COLLECTION AND ANALYSIS

1923 members of the Chartered Institute of Purchasing and Supply Australia (CIPSA) were surveyed between April and June 2006. Results are based on the responses of 207 purchasing and procurement professionals. The completed questionnaires were separated into two groups: product based organizations and service based organizations -- 138 being from product related organizations, 68 from service related organizations (1 unclassified was removed from the analysis). The response rate is estimated at 11% (74 surveys were “returned to sender”). Figure 1 shows the breakdown of survey response. This study used SPSS version 13.0 for Windows to facilitate data analysis.

![Figure 1: Breakdown of survey response](image-url)
The Impact of Demand and Supply Uncertainty on Business Performances

The first question of interest relates to the nature of the impact of demand and supply uncertainty on business performance. The results for both product and service based organizations are reported below.

Comparative Assessment of Business Performance under Different Level of Demand and Supply Uncertainty -- Products

Product based organizations (see Figures 2 & 3 below) indicated that business performance was significantly better when supply uncertainty was low in the areas of delivery, flexibility and customer focus. Interestingly this did not appear to necessarily translate into better financial performance. When demand uncertainty was low, only delivery performance was reported to be significantly better, with all other areas of performance measured reported to be effectively unchanged.

Figure 2: Comparative Assessment of Business Performances: mean score for organizations under low demand uncertainty VS. high demand uncertainty (Products)

Figure 3: Comparative Assessment of Business Performances: mean score for organizations under low supply uncertainty VS. high supply uncertainty (Products)
Comparative Assessment of Business Performance under Different Level of Demand and Supply Uncertainty – Services

The results were similar for service based organizations (see Figures 4 & 5 below) with demand uncertainty playing even less of a role in affecting performance. In this case there was no significant change in performance recorded based on levels of demand uncertainty. On the other hand, supply uncertainty did appear to affect performance significantly in the areas of delivery and cycle time, as well as having some financial impact.

Figure 4: Comparative Assessment of Business Performances: mean score for organizations under low demand uncertainty VS. high demand uncertainty (Services)

Figure 5: Comparative Assessment of Business Performances: mean score for organizations under low supply uncertainty VS. high supply uncertainty (Services)
The results from both sectors indicate that supply uncertainty is a more significant determinant of performance than demand uncertainty in both product and service related organizations. The implications are important for organizations developing supply chain management strategies, particularly in terms of where to focus attention in managing uncertainty levels. Managing supplier uncertainty would appear to be a more significant source of leverage in both sectors. It is particularly interesting to note that this is as much the case in services, given that in this sector the customer is often a participant in the supply process.

**The Impact of Supplier Partnership and Customer Relationship on Business Performance**

The second question of interest relates to whether the nature of relationships with suppliers and customers have an impact on business performance. The results for both product and service based organizations are reported below.

**Comparative Assessment of Business Performance under Different Level of Supplier Partnership and Customer Relationship – Products**

The data reported in Figures 6 & 7 below indicates that closer relationships with both customers and suppliers are related to higher levels of performance in all the areas measured. There is also some evidence suggesting that the gap in performance is greater when relationships with customers are poor.

![Business Performance under Different Level of Supplier Relationship (Products)](chart)

Figure 6: Comparative Assessment of Business Performances: mean score for organizations under low supplier relationship vs. high supplier relationship (Products)
Figure 7: Comparative Assessment of Business Performances: mean score for organizations under low customer relationship vs. high customer relationship (Services)

Comparative Assessment of Business Performance under Different Level of Customer Closeness and Supplier Partnership – Services
In the services sector (see Figures 8 & 9 below) similar results were recorded as for the product based organizations. Again, relationships with both types of trading partner were found to be important in determining performance levels. At the same time, there was also evidence showing that poor relationships with customers yield significantly lower levels of performance in the service sector.

Figure 8: Comparative Assessment of Business Performances: mean score for organizations under low supplier relationship VS. high supplier relationship (Services)
Figure 9: Comparative Assessment of Business Performances: mean score for organizations under low customer relationship VS. high customer relationship (Services)

Overall these results indicate that closer relationships with trading partners are associated with higher levels of performance in both product and service based organizations. This is highlighted by the results reported in Table 1 below. This table shows the proportion of variance in each of the performance categories explained by the nature of trading partner relationships. In summary, these results indicate that: (a) both types of relationship are important in both sectors; (b) in product based organizations the effect is greater in operational areas of performance; and (c) in service based organizations the impact is more directly related to the bottom line through improved financial performance. Interestingly, this third effect is more strongly influenced in services by the supplier relationship than that with customers.

<table>
<thead>
<tr>
<th></th>
<th>Products</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supplier Partnership</td>
<td>Customer Partnership</td>
</tr>
<tr>
<td>Performance Delivery</td>
<td>13% ***</td>
<td>21.7% ***</td>
</tr>
<tr>
<td>Performance Time</td>
<td>7.9% ***</td>
<td>3.5% *</td>
</tr>
<tr>
<td>Performance Customer</td>
<td>16.2% ***</td>
<td>20.8% ***</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>14.6% ***</td>
<td>17.5% ***</td>
</tr>
<tr>
<td>Performance Flexibility</td>
<td>2.4% *</td>
<td>-0.2%</td>
</tr>
</tbody>
</table>

** % of variance explained is (statistically) extremely significant at P < 0.001 level,
*** % of variance explained is (statistically) very significant at P < 0.01 level,
* % of variance explained is significant at P < 0.05 level

Table 1: Percentage of variance of business performance which can be explained by level of supplier relationship and customer relationship
The association between supplier partnership AND customer closeness and level of demand and supply uncertainty

The third question of interest in this study is to understand the extent to which supplier and customer relationships influence the level of demand and supply uncertainty. Table 2 below shows the correlation between trading partner relationships and levels of uncertainty for product based organizations. The results indicate that both supply and demand uncertainty are negatively correlated with close trading partner relationships. In other words, uncertainty can be reduced by being more closely aligned with both suppliers and customers. It is also interesting to note that closer ties with both customers and suppliers have a significantly stronger impact on reducing supply rather than demand uncertainty.

<table>
<thead>
<tr>
<th></th>
<th>Demand Uncertainty</th>
<th>Supply Uncertainty</th>
<th>Supplier Partnership</th>
<th>Customer Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Uncertainty</td>
<td>1</td>
<td>.221(**)</td>
<td>-.173(*)</td>
<td>-.169(*)</td>
</tr>
<tr>
<td>Supply Uncertainty</td>
<td>.221(**)</td>
<td>1</td>
<td>-.375(**)</td>
<td>-.441(***+)</td>
</tr>
<tr>
<td>Supplier Partnership</td>
<td>-.173(*)</td>
<td>-.375(**)</td>
<td>1</td>
<td>.444(***+)</td>
</tr>
<tr>
<td>Customer Partnership</td>
<td>-.169(+)</td>
<td>-.441(***+)</td>
<td>.444(***+)</td>
<td>1</td>
</tr>
</tbody>
</table>

*** Correlation is significant at the 0.001 level (2-tailed)
**  Correlation is significant at the 0.01 level (2-tailed).
*  Correlation is significant at the 0.05 level (2-tailed).

Table 2: Correlation of Supplier Relationship and Customer Relationship with Demand and Supply Uncertainty – Product Organizations

Table 3 below shows the correlation between trading partner relationships and levels of uncertainty for service based organizations. In this case the results bear a sharp contrast to those for the product based organizations reported above. Only one significant relationship was found, in this case a positive one between closer ties with customers and demand uncertainty. The overall result in this sector indicates that closer ties with customers and suppliers will not reduce levels of uncertainty on either the supply or demand side.

<table>
<thead>
<tr>
<th></th>
<th>Demand Uncertainty</th>
<th>Supply Uncertainty</th>
<th>Supplier Partnership</th>
<th>Customer Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Uncertainty</td>
<td>1</td>
<td>-.014</td>
<td>.180</td>
<td>.281(*)</td>
</tr>
<tr>
<td>Supply Uncertainty</td>
<td>-.014</td>
<td>1</td>
<td>-.097</td>
<td>-.011</td>
</tr>
<tr>
<td>Supplier Partnership</td>
<td>.180</td>
<td>-.097</td>
<td>1</td>
<td>.430(***+)</td>
</tr>
<tr>
<td>Customer Partnership</td>
<td>.281(*)</td>
<td>.011</td>
<td>.430(***+)</td>
<td>1</td>
</tr>
</tbody>
</table>

*** Correlation is significant at the 0.001 level (2-tailed)
**  Correlation is significant at the 0.01 level (2-tailed).
*  Correlation is significant at the 0.05 level (2-tailed).

Table 3: Correlation of Supplier Relationship and Customer Relationship to Demand and Supply Uncertainty – Service Organizations
MANAGERIAL IMPLICATIONS

The implications for managers are important. The results provide substantial evidence for the benefits of closer relations with trading partners whether an organization is making products or providing services. The evidence indicates that the nature of relationships with trading partners is closely associated with higher levels of both operational and financial performance. Uncertainty is something that all organizations must deal with, and in a supply chain the results indicate that uncertainty of supply is a stronger determinant of performance than uncertainty of demand. This was found to be the case even in services, an interesting result given the extent of involvement with customers typically found in this sector. The counterintuitive implication of the results overall is that managers (in product based organizations) wishing to reduce levels of uncertainty in supply will best be served by developing closer ties with both customers and suppliers. In this case higher levels of performance are more likely as a result of both the nature of the relationship and reductions in supply uncertainty. In service based organizations, managers also will be well served by doing the same, but for different reasons. In these organizations closer relationships with trading partners can lead to improved performance, but not through reductions in supply uncertainty.

CONCLUSION

In this paper, the relationships between supply chain uncertainty, supply chain relationships and firm’s performance were investigated in both product and service related organizations. The study surveyed 1923 purchasing and procurement professionals who are members of CIPS Australia. The results were reported based on 206 responses. The results indicate that: (a) supply uncertainty is a more significant determinant of performance than demand uncertainty in both product and service related organizations; (b) closer relationships with trading partners are associated with higher levels of performance in both product and service based organizations; and (c) uncertainty can be reduced by being more closely aligned with both suppliers and customers in product based organizations, while in service based organizations, closer relationship with suppliers and customers does not reduce the level of uncertainty.
REFERENCES


